MYP by Concept
4&5

Music

Samuel Wright

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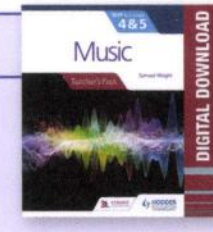

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9781510478145

- Plan and deliver inventive lessons with unit planners that contain comprehensive teaching notes and guidance mapped to the activities and resources in the Student's Book.
- Take learning further with additional activities and extension exercises that build on the content in the Student's Book.
- Explore subjects in more depth with extensive lists of additional resources and links to useful websites.

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Music

Samuel Wright
Series editor: Paul Morris

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Finally, I would like to thank my wife, Laura, and boys Joshua and Caleb who made this publication possible! I could not have done this without your support.

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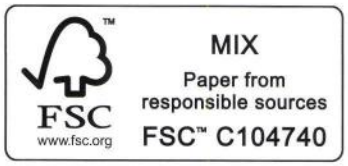
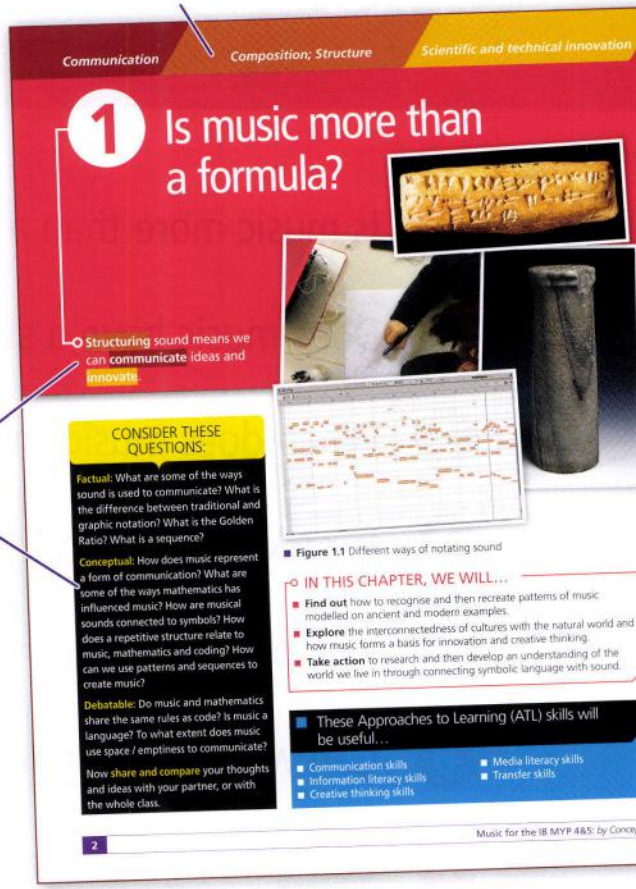


Contents

How to use this book

Welcome to Hodder Education's *MYP by Concept* Series! Each chapter is designed to lead you through an *inquiry* into the concepts of Music, and how they interact in real-life global contexts.

Each chapter is framed with a *Key concept*, *Related concept* and set in a *Global context*.



The *Statement of Inquiry* provides the framework for this inquiry, and the Inquiry questions then lead us through the exploration as they are developed through each chapter.

KEY WORDS

Key words are included to give you access to vocabulary for the topic. **Glossary terms** are highlighted and, where applicable, **visible thinking routines** are given to encourage their use.

! Take Action

! Whereas this book provides for multiple modes of engagement and exploration, you need to take an active role in the process of sharing and connecting to the world around you. Practise your research, develop good questioning skills, and apply them to the musical world we now find ourselves immersed in.

■ ATL

Activities are designed to develop your Approaches to Learning (ATL) skills.

◆ Assessment opportunities in this chapter:

Some activities are *formative* as they allow you to practise certain parts of the MYP Music Assessment Objectives. Other activities can be used by you or your teachers to assess your achievement *summatively* against all parts of an assessment objective.

Hint

In some of the activities, we provide hints to help you work on the assignment.

Listening strategically: Get an IDEA

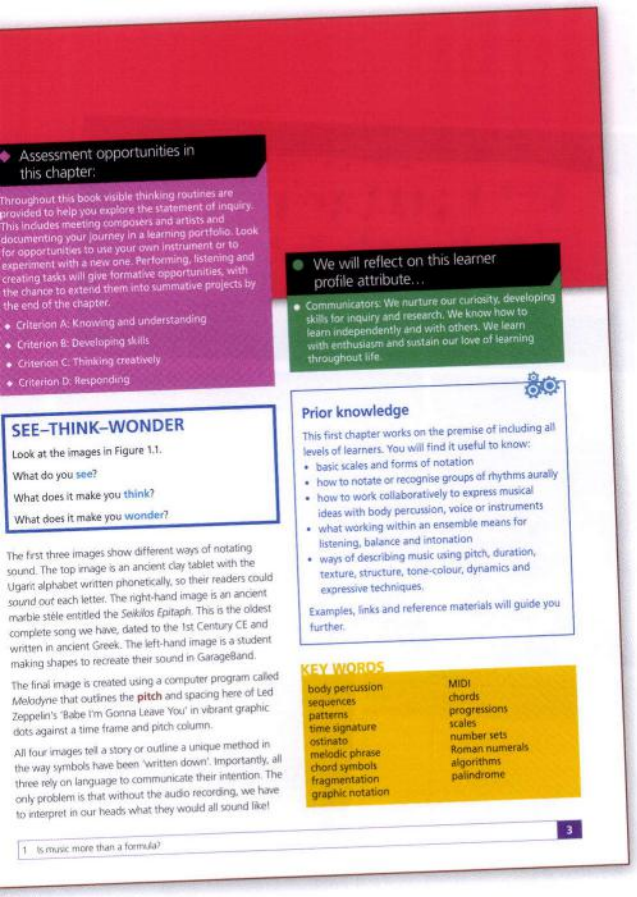
When you listen to music, try to think of the acronym **IDEA** (**identify**, **describe**, **explain** and **analyse**) to help you respond with knowledge, and correct terminology. These boxes will prompt you to do just that.

EXTENSION

Extension activities allow you to explore a topic further.

You are prompted to consider your conceptual understanding in a variety of activities throughout each chapter.

We have incorporated Visible Thinking – ideas, framework, protocol and thinking routines – from Project Zero at the Harvard Graduate School of Education into many of our activities.



Assessment opportunities in this chapter:

Throughout this book visible thinking routines are provided to help you explore the statement of inquiry. This includes meeting composers and artists and documenting your journey in a learning portfolio. Look for opportunities to use your own instrument or to experiment with a new one. Performing, listening and creating tasks will give formative opportunities, with the chance to extend them into summative projects by the end of the chapter.

- Criterion A: Knowing and understanding
- Criterion B: Developing skills
- Criterion C: Thinking creatively
- Criterion D: Responding

We will reflect on this learner profile attribute...

- Communicators: We nurture our curiosity, developing skills for inquiry and research. We know how to learn independently and with others. We learn with enthusiasm and sustain our love of learning throughout life.

SEE–THINK–WONDER

Look at the images in Figure 1.1.

What do you see?

What does it make you think?

What does it make you wonder?

Prior knowledge

This first chapter works on the premise of including all levels of learners. You will find it useful to know:

- basic scales and forms of notation
- how to notate or recognise groups of rhythms aurally
- how to work collaboratively to express musical ideas with body percussion, voice or instruments
- what working within an ensemble means for listening, balance and intonation
- ways of describing music using pitch, duration, texture, structure, tone-colour, dynamics and expressive techniques.

Examples, links and reference materials will guide you further.

The first three images show different ways of notating sound. The top image is an ancient clay tablet with the Ugarit alphabet written phonetically, so their readers could sound out each letter. The right-hand image is an ancient marble stèle entitled the *Seikilos Epitaph*. This is the oldest complete song we have, dated to the 1st Century CE and written in ancient Greek. The left-hand image is a student making shapes to recreate their sound in GarageBand.

The final image is created using a computer program called *Melodyne* that outlines the **pitch** and spacing here of Led Zeppelin's 'Babe I'm Gonna Leave You' in vibrant graphic dots against a time frame and pitch column.

All four images tell a story or outline a unique method in the way symbols have been 'written down'. Importantly, all three rely on language to communicate their intention. The only problem is that without the audio recording, we have to interpret in our heads what they would all sound like!

KEY WORDS

body percussion, sequences, patterns, time signature, ostinato, melodic phrase, chord symbols, fragmentation, graphic notation, MIDI, chords, progressions, scales, number sets, Roman numerals, algorithms, palindrome

1 Is music more than a formula? 3

A playlist has been compiled of all the pieces of music referenced throughout the book. Whenever the playlist is mentioned, you can access it here:

- **https://bit.ly/HodderMYPMusiciTunes**
- **https://bit.ly/HodderMYPMusicSpotify**
- **https://bit.ly/HodderMYPMusicYouTube**

Links to:

Like any other subject, Music is just one part of our bigger picture of the world. Links to other subjects are discussed.

We will reflect on this learner profile attribute...

- Each chapter has an IB learner profile attribute as its theme, and you are encouraged to reflect on these too.

Portfolio presentation

You are expected to document your learning in a Portfolio. Activities designed especially for your portfolio are provided throughout.

MEET THE COMPOSER / MUSICIAN / ARTIST

These boxes will introduce you to significant people in the field of music, providing background and short biographies.

Music exploration

Terminology useful to your studies is explained.

Missions and Cases

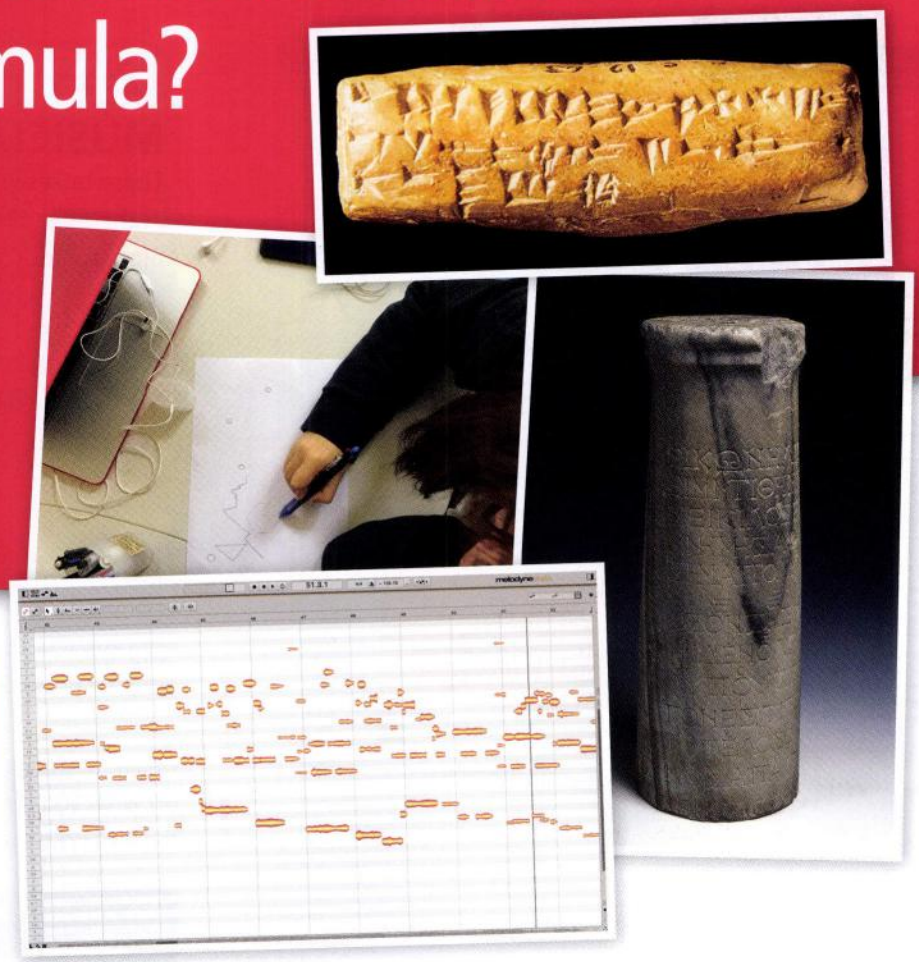
Some chapters focus on computer games, court cases or research missions for you to complete. The focus is on improving research and documenting your responses.

Finally, at the end of the chapter you are asked to reflect back on what you have learnt with our Reflection table, maybe to think of new questions brought to light by your learning.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual					
Conceptual					
Debatable					
Approaches to learning you used in this chapter	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Learner profile attribute	Reflect on the importance of the attribute for your learning in this chapter.				

1 Is music more than a formula?

Structuring sound means we can **communicate** ideas and **innovate**.



■ **Figure 1.1** Different ways of notating sound

CONSIDER THESE QUESTIONS:

Factual: What are some of the ways sound is used to communicate? What is the difference between traditional and graphic notation? What is the Golden Ratio? What is a sequence?

Conceptual: How does music represent a form of communication? What are some of the ways mathematics has influenced music? How are musical sounds connected to symbols? How does a repetitive structure relate to music, mathematics and coding? How can we use patterns and sequences to create music?

Debatable: Do music and mathematics share the same rules as code? Is music a language? To what extent does music use space / emptiness to communicate?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL...

- **Find out** how to recognise and then recreate patterns of music modelled on ancient and modern examples.
- **Explore** the interconnectedness of cultures with the natural world and how music forms a basis for innovation and creative thinking.
- **Take action** to research and then develop an understanding of the world we live in through connecting symbolic language with sound.

These Approaches to Learning (ATL) skills will be useful...

- Communication skills
- Information literacy skills
- Creative thinking skills
- Media literacy skills
- Transfer skills

Assessment opportunities in this chapter:

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KEY WORDS

body percussion
sequences
patterns
time signature
ostinato
melodic phrase
chord symbols
fragmentation
graphic notation
MIDI
chords
progressions
scales
number sets
Roman numerals
algorithms
palindrome

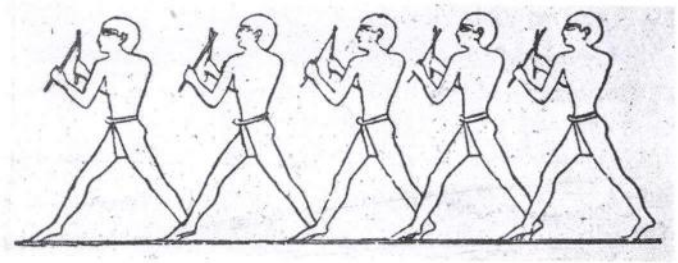
What are some of the ways sound is used to communicate?

HOW HAS MUSIC BEEN COMMUNICATED THROUGHOUT HISTORY?

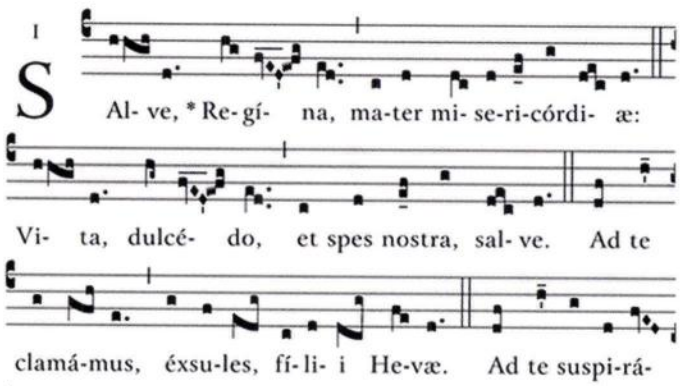
Notation, or writing down ideas for the purpose of communicating, is not a new concept, but the methods of notation demonstrate something of humankind's musical innovations through time. We have used everything from words, symbols and numbers, to shapes, colours and little dots to show. Why? It could be to record ideas, pass on stories or inform other musicians what to play and how they should play it.

One of the oldest musical instruments known to us is from Ancient Egypt, the *one-handed clapper*. Figure 1.2a shows that the playing of these instruments by female dancers was to keep those who were treading grapes in time with each other. Then if we jump forward to the 9th Century CE, we have modern *plainchant* (sung **chants**) written in the form of small dots and dashes called *neumes*. These graphical symbols are placed on four lines, and each neume carries one syllable of text tone sung (See Figure 1.2b.). In both cases, the symbols are instructions to show and demonstrate the nature of the music being recorded.

Over a century later, Guido of Arezzo (c. 1025) brings to light the chant *Ut queant laxis* with the syllables *ut re mi fa sol la*. Notice that each phrase begins with the next syllable as its following 'step'.

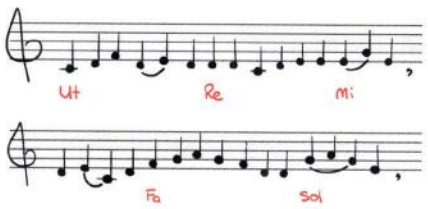


a



b

■ **Figure 1.2 a** Harvesters with concussion sticks. One of the oldest musical instruments known to us is from Ancient Egypt, **b** 9th Century CE modern plainchant (sung chant) *Salve Regina*



■ **Figure 1.3** Guido of Arezzo's *Ut Re Mi* chant

DISCUSS

Think about these two questions and then turn to a partner to **discuss** your answers:

1. **What could be some problems with the forms of 'musical notation' discussed above?**
2. **How do you think the Egyptians could have notated (written down) their clapping patterns?**

ACTIVITY: Twitter bot

ATL

- Creative thinking skills: Generating novel ideas and considering new perspectives

There is a bot on Twitter that regularly sends out examples of graphic notation for musicians to **create** or *perform* from. Visit **https://twitter.com/graphicscorebot**, choose one and work on performing it with body percussion and **vocussion**.

Your aim is to interpret the image within a fixed timeframe. Connect colours to certain sounds, and if there are lines and shapes you get to decide how long, soft, loud or high those sounds are interpreted. If you cannot access Twitter, **use** Figure 1.4.

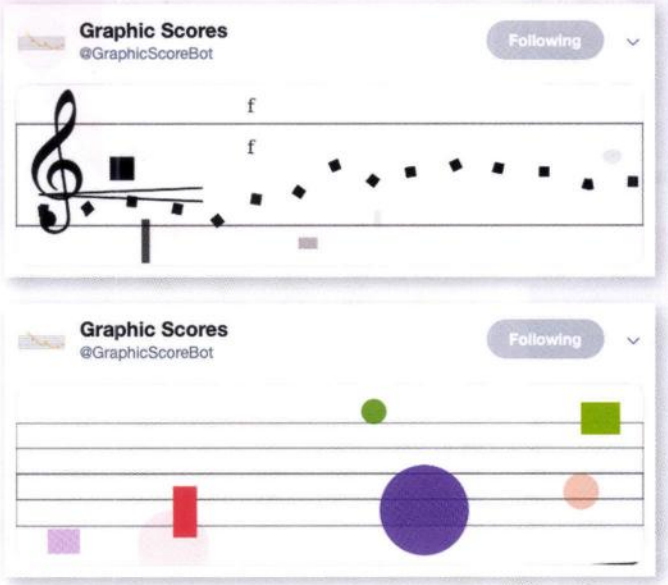


Figure 1.4 Graphic scoring examples from Twitter

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion D: Responding.

Portfolio presentation

Creating a portfolio

Keeping a *portfolio* or *journal* while studying music is very important. You are expected to document your learning, the ideas you engage with and why you chose those ideas (your *process*). It is recommended that you have a manuscript book of some description and the ability to make and store videos / screenshots of your work.

BookCreator is a fantastic tool on Mac / Windows as well as iPad / Chrome. Pages on a Mac can also store both video and audio. Also check other learning systems and blogs provided by your school. These are suitable so long as they allow you to craft, curate and publish your ideas safely. Don't forget that technology is a powerful tool for making learning visible, if done in the correct way.

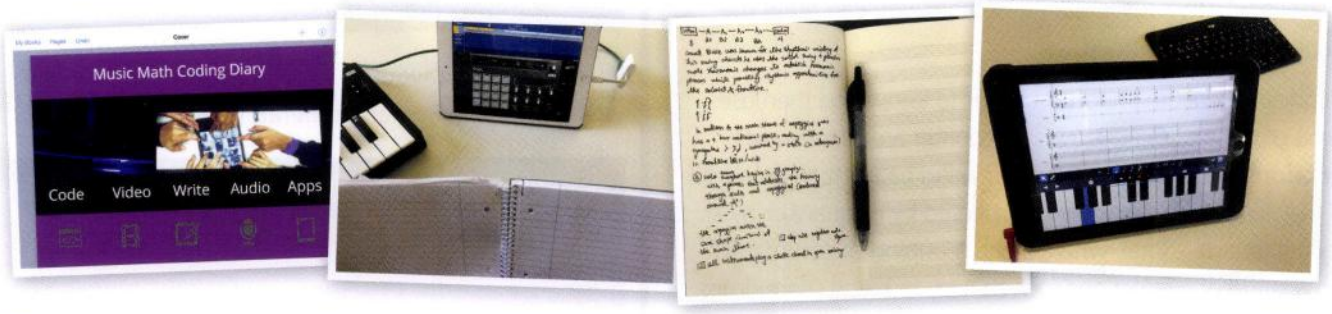
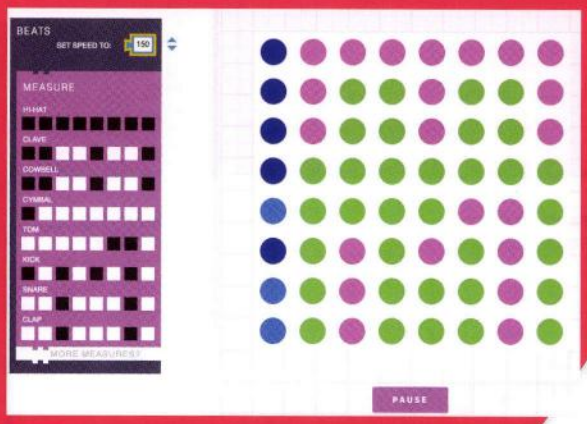
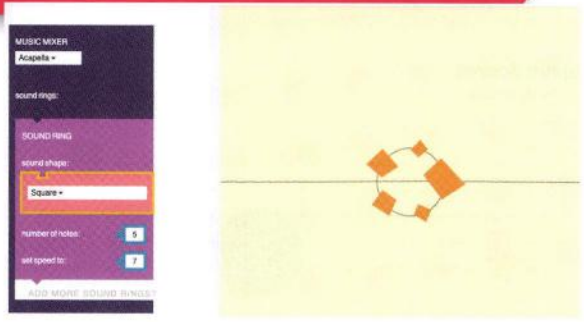


Figure 1.5 Ways to document your learning





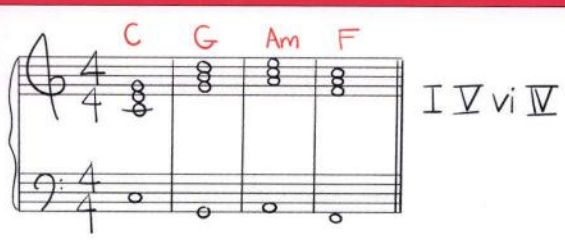
■ **Figure 1.6** Examples of block-style coding

WHAT IS A LOOP, FUNCTION OR COMMAND?

Coding can be a complicated process when you are starting out. Fortunately there are many online tutorials to help you get started. You can visit **http://code.org** for an introduction; however, we will go to 'Made With Code' to start making beats within a visual framework:
https://legacy.madewithcode.com/project/beats

As you have seen, symbols from ancient times to the present can be used to represent sound. This is a form of coding. Here we have two programmable options for creating music. First we can program beats using a grid of boxes, or second we can program a group of pitches using rotating shapes (see Figure 1.6). Spend some time experimenting with the two options and write in your portfolio what you created. Remember, you can draw the shapes you programmed.

In coding, there are important terms to know and then use. Some of the first ones you will encounter are **commands**, **functions** and **loops**. If you are making beats, the command of 'play kick drum' could be represented by a square or by a crochet (quarter-note), whereas the grouping of commands into a string of instructions such as 'play kick and snare drum on counts 1, 2, 3, 4' is called a *function*. Loops are simply repetitions of commands and functions for a set time period.



■ **Figure 1.7** Chord progression: Snow Patrol

This means that music has its own built-in code functions that we naturally just perform. Take **chords**, for example: Chords are three or more notes, stacked on top of each other to form what is called a **triad**. They are then often arranged into a string of more chords called a **progression**.

One of the best websites to see this visually is **www.HookTheory.com** and the example song 'Run' by Snow Patrol uses the chords C major, G major, A minor and F major: **www.hooktheory.com/theorytab/view/snow-patrol/run**

In music theory, we use Roman numerals to represent chords visually. This is shown as I-V-vi-IV where C major is the 1st chord, G major the 5th, A minor the 6th and F major the 4th. This means we can write a function to say 'play the chorus of a song using the progression I-V-vi-IV'.

Did you notice the difference between both major and minor chords and the upper and lower cases of the Roman numerals? The chord A minor has a different sound quality so it has a lower-case *vi*, where all the others have upper-case symbols.

ACTIVITY: Beats, chords and code

■ ATL

■ Media literacy skills: Interacting with media to use and create ideas and information

Search for your favourite song(s) on HookTheory and write down the Roman numerals in your portfolio.

◆ Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding.

Take action

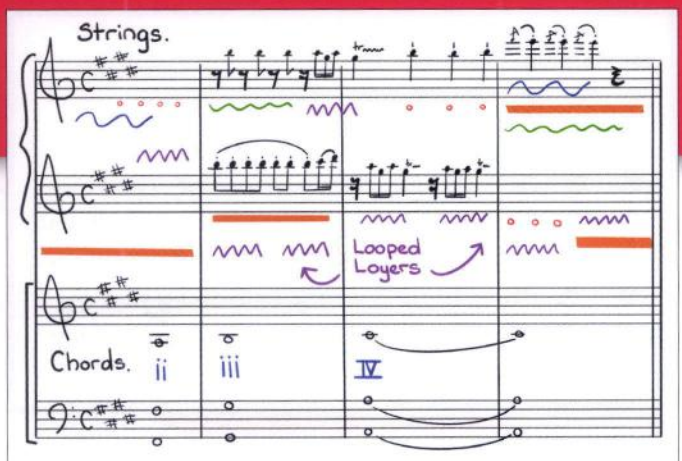
- Research and then develop an understanding of the world we live in through connecting symbolic language with sound.
- The *Hour of Code* is a global event held each year during Computer Science Education Week. Collaborate with your school, or organise a 'Music-Coding' event using Sonic Pi (**https://sonic-pi.net**) and micro:bit (**https://microbit.org**). As well as participating in the *Hour of Code*, you can finish off each session with a concert of coded music.

HOW ARE MUSICAL SOUNDS CONNECTED TO SYMBOLS?

The world of music has changed with technology. The way humans adapt their needs to their surroundings has meant we find solutions to create new sounds wherever we are.

One of the oldest surviving instruments known today is a flute carved from a crane's bone, dating to the Shang Chinese people of the 14th Century BCE. From there, humans have developed various **idiophones**, **chordophones**, **aerophones**, **membranophones** and now **electrophones**. The ethnomusicologist Curt Sachs, in his book *The History of Musical Instruments*, classifies instruments by their **tone-colour**. By grouping instruments this way, we can actually call on them, like a function, when we want to group particular sounds in music.

Listen to an excerpt of Antonio Vivaldi's 'Spring', reworked by modern composer Max Richter using chordophones and an electrophone, on the playlist. Richter has taken the melodic string parts and **fragmented** their **pitch material** into smaller looped patterns that are then layered over a low sustained chord progression.



■ **Figure 1.8** Max Richter's 'Spring 1' showing violin loops against rising chords ii-iii-IV (mm30–33)

Music has symbols, and communicates as a language with properties similar to mathematics and coding. Max Richter understands how loops can fit within a musical piece because he understands the building blocks of music. By applying knowledge of the building blocks, we can discuss examples from metal to medieval. These building blocks will be repeated throughout this book in activities and side missions: pitch, **rhythm**, texture, structure, tone-colour (timbre), dynamics and expressive techniques.

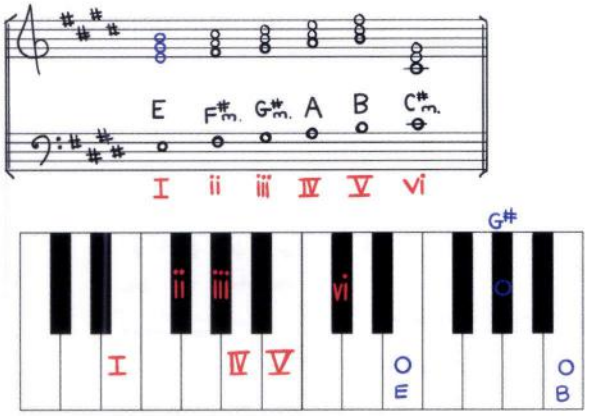
ACTIVITY: How does music communicate with code?

ATL

- Media literacy skills: Comparing, contrasting and drawing connections among (multi)media resources

Using the Max Richter example above, can you see how coding language could have been used to **create** this version of Vivaldi's 'Spring'?

Using the Roman numeral chords provided, change their order and experiment with playing the chords in Figure 1.9 on an instrument. By repeating and overlapping different notes, Richter is able to achieve a continuously evolving texture. Can you do the same in a small group or with your class?



■ **Figure 1.9** Chord-progression activity

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding.

EXTENSION

Visit the Deutsche Grammophon website to download the app for iOS by Touchpress with both Vivaldi's and Richter's versions of 'The Four Seasons': **www.deutschegrammophon.com/en/album/ipad-app-vivaldis-vier-jahreszeiten.html**. You will see traditional and graphic notation side by side as the work is performed. This is an innovative way of combining technologies.

Listening strategically: Get an IDEA

When you listen to music, try to think of the following acronym to help you respond with knowledge, and correct terminology:

Identify the sounds, or patterns you hear.

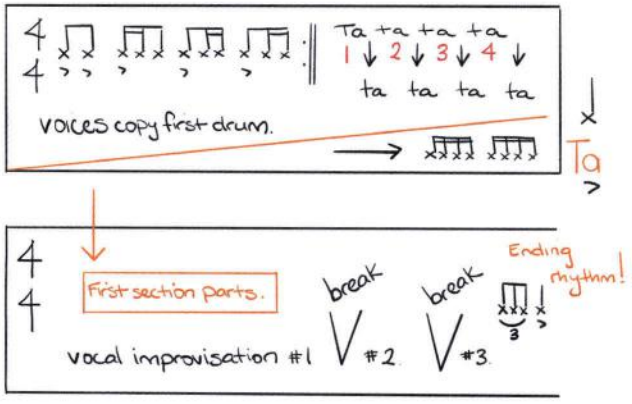
Describe how they are being played, presented, layered.

Explain what role they play in the structure of the work.

Analyse the smaller parts (**intervals**, **motifs**, **sequences**) to their outward larger parts of form, modulations, phrases and **cadences**.

Listen to the track 'Vocussion' from the album *New Impossibilities* by the Silk Road Ensemble. As you listen, can you imitate each layer of sound? Better yet, notate them as symbols? What sounds or patterns can you **Identify**? **Describe**? **Explain**? **Analyse**?

An example is provided below to help you start practising for your portfolio.



■ **Figure 1.10** Vocussion graphic map

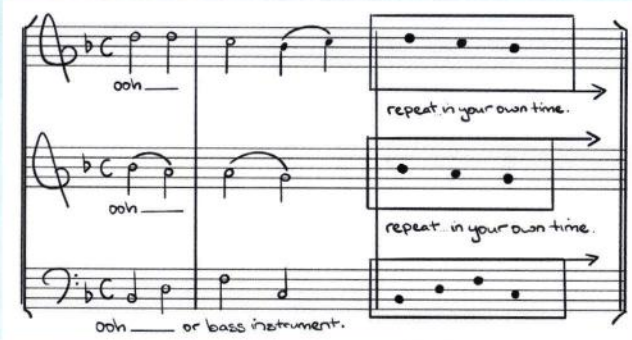
MEET THE COMPOSER: ERIC WHITACRE

■ **Figure 1.11** An image from the Hubble Telescope

Deep Field is a work composed by Eric Whitacre based on the Hubble Telescope. He was inspired by the struggle and beauty that accompanied the creation of the photos taken by the telescope. Whitacre is a composer who uses the human voice and an innovative approach to technology. He even combined choral singing with dubstep in his work entitled 'Fly to Paradise'.

Using the internet and singers around the world, Whitacre composed *Deep Field* using a form of notation that included an overlapping pattern of musical sounds, much like the stars and constellations in space. A similar example based on *Deep Field* has been composed for you to try and sing or play in your classroom. What do you notice about the way the melodic parts have been written?

Visit the website of Whitacre's *Deep Field* to watch the film and then complete all the badges as you learn about Whitacre's approach to combining science and music: **https://deepfieldfilm.com/badges**



■ **Figure 1.12** Vocal performance piece: Use the boxed notes to experiment with the length, dynamics and spacing of each part

What are some of the ways mathematics has influenced music?

SEE–THINK–WONDER

Look at the image of the spiral galaxy taken by the Hubble Telescope in 2018 in Figure 1.11. What do you **see**? What does it make you **think**? What does it make you **wonder**?

Create a heading in your portfolio and add your responses to these questions as well as your classroom performance **using** Figure 1.12.

WHAT IS THE GOLDEN RATIO?

Mathematics is an amazing language of symbols, ratios, number sets (recurring groupings of natural numbers, integers, rational and real numbers) plus operations, all interacting with each other. We spend time learning the rules and order of operations so that we can utilise and engage with this language called *mathematics*. Music can be exactly the same. In fact, musicians can give voice to many types of different symbols, express emotion through ratios, combine sets or groups of sounds and communicate these to any audience around the world.

According to the book *Incredible Numbers* by Professor Ian Stewart, '… Leonardo of Pisa (1202) wrote an arithmetic text, the *Liber Abbaci* (*Book of Calculation*) explaining Hindu–Arabic numerals 0–9 to a European audience'. This text included an example from studying the breeding habits of rabbits. He was later nicknamed Fibonacci, as was his number set of 1, 1, 2, 3, 5, 8, 13, 21, 34, and so on. Notice the pattern of adding the first two numbers to get the next in the sequence? 1+1=2, 1+2=3, and so on. This led to even further discoveries of the same occurrence in nature, from cones to shells and the Milky Way.

Artists (such as Da Vinci) have used it for painting human subjects, and architects have used it for aligning proportions (such as in ancient Greek monuments).

■ **Figure 1.13** *Incredible Numbers* by Prof. Ian Stewart

Composers including Bach, Schubert, Bartok and Debussy have used it to structure their works. Bach's first book of inventions contains 15 pieces in carefully arranged musical keys. Observe how Bach set about organising the pieces with the *Golden Ratio* (≈ 1.62) and as a **palindrome**. Fifteen pieces divided by 1.62 gives us the middle work in the palindrome, of A major.

Piece and key	Meter
1 **C major**	4/4
2 d minor	3/8
3 e minor	4/4
4 F major	3/4
5 G major	9/8
6 a minor	4/4
7 b minor	4/4
8 B-flat major	4/4
9 A major = **Golden Ratio**	**12/8**
10 g minor	4/4
11 f minor	3/4
12 E major	3/8
13 E-flat major	4/4
14 D major	3/8
15 c minor	4/4

■ **Figure 1.14** Patterns in Bach's first book of Inventions read forwards and backwards

ACTIVITY: Fibonacci as a structure

ATL

- Creative thinking skills: Generating novel ideas and considering new perspectives

Wolfgang Amadeus Mozart was known as a composer of particular lyrical genius. We are going to look at how he structured the following solo piano work around the Golden Ratio. The *structure* of a work is how it is put together, piece by piece, layer by layer. This includes all the connecting parts that help Mozart's ideas transition between rhythm, harmony and melody in the *form* called a **sonata**. Mozart cleverly approaches the overall structure by using the Golden Ratio:

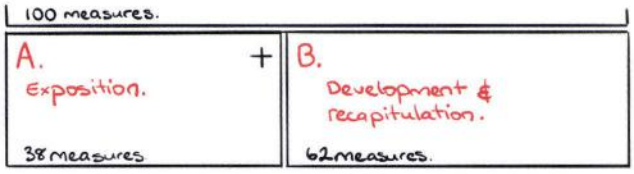


Figure 1.15 Mozart's 'Piano Sonata No. 1 in C Major K279'

The **exposition** is where the main melodic ideas are communicated. Mozart does this in 38 bars.

The **development** is where a composer expands and embellishes their ideas. Combined with the **recapitulation** that brings back the opening material, Mozart uses 62 measures to accomplish this. Within the whole of 100 measures it is structured perfectly as 38+62 or 100/1.62 (the Golden Ratio).

In your portfolio, make a list of the methods for **using** the Golden Ratio or Fibonacci sequences to structure a musical work, showing:

1. **an overarching form,**
2. **the lyrics, and**
3. **the rhythm.**

What other ways and methods might work? Brainstorm a few with your class using the pieces discussed as inspiration. **Create** a mind-map of your findings and record on your device or laptop any musical versions that you create.

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowledge and understanding and Criterion D: Responding.

We've just seen how Mozart used the Golden Ratio to structure his sonata, but what about using the Fibonacci numbers within a different structure?

Duo, Mos Def and Talib Kweli have done exactly this with their song 'Astronomy (8th Light)' by outlining the Fibonacci progression in their rapped chorus. This provides a returning theme (or stanza) that unifies the entire work. Visit the video on YouTube and listen for the numbers 1, 2, 3, 5, 8. **https://youtu.be/0d8iu1lE-cM**

Now take a look at how Hungarian composer Bela Bartok used the same set of numbers for a rhythmical structure in the third **movement** of his *Music for Strings, Percussion and Celeste*. Bartok created a palindrome melody for the xylophone with a rhythmic focus on 1 1 2 3 5 8 5 3 2 1 1.

EXTENSION

Ensemble puzzle

Try solving this musical puzzle: If you clap a beat in 4/4 time with 8 **quavers** (8th notes) in each bar, how could you represent a Fibonacci pattern while just clapping?

Hint

Use accents!

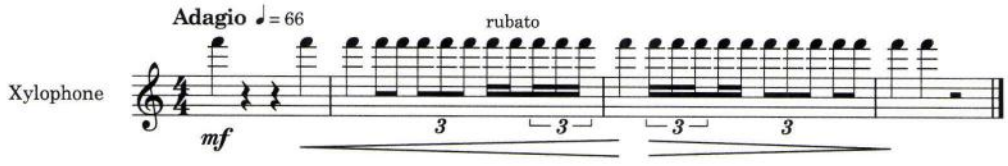


Figure 1.16 Bartok's *Music for Strings, Percussion and Celeste* '3rd movement'

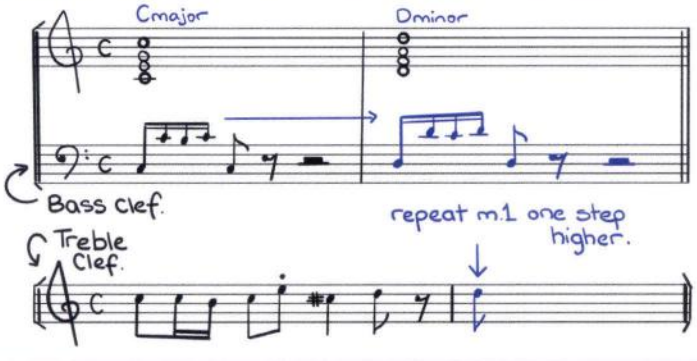
How can we use patterns and sequences to create music?

■ **Figure 1.17** Examples of Fibonacci in nature

WHAT IS A SEQUENCE?

Music exploration: Earworms and sequences

Using the opening of Mozart's 'Piano Sonata No. 1 in C Major K279', let us have a quick look at the melody and an important *musical pattern* called a *sequence*. Mozart cleverly writes melodies that repeat and get stuck in your head like an 'earworm'. One of the ways he accomplishes this is by repeating a string of notes in the exact same way, just a little higher or lower. The work below opens with 4 bars of notes that are played over a C major and then D minor chord (I-ii, I-ii). Then in measures 5 to 8 a melody is repeated in the top part but ascending a little higher each time. This is called a *sequence* and it allows you to repeat material, as long as it is based upon the very first version. See if you can make a series of sequences like Mozart's by continuing the pattern:



■ **Figure 1.18** Sequence example from Mozart. See the sequence in blue?

EXTENSION

Ensemble performance

Try warming up on your rhythms, **scales** and **arpeggios**, but only accent certain number patterns, such as 3+4, 2+1, 1+3, 8, 5, 3, 2, 1. Then **create** a sequence of notes and rhythms that will help you **explore** your instrument. You could even try Bartok's Palindrome of 1 1 2 3 5 8 5 3 2 1 1. Your warm-ups will improve out of sight.

Listening strategically: Get an IDEA

When you listen to music, try to think of the acronym **IDEA** to help you respond with knowledge, and correct terminology.

Listen to the piano sonata 'K279 No. 1' by Mozart. As you listen, can you sketch the structure of the work? Include changes in rhythm or melody as smaller observations. What sounds or patterns can you **Identify**? **Describe**? **Explain**? **Analyse**?

ACTIVITY: Fibonacci body percussion

ATL

Collaboration skills: Working effectively with others

Having a predetermined structure in mathematics, nature and music is incredible. It can free us up to be more creative when we know the framework to work within. The spiral and combination of the Fibonacci sequence opposite clearly **outlines** the macro image of a larger rectangle made up of smaller, yet proportionally equal, rectangles. What if we could **use** this as our basis for making music together?

Using the Fibonacci sequence you are going to interpret the numbers shown opposite into a rhythmically complex work.

1. **Break into eight pairs or groups, and choose one rectangle from this golden spiral (Fibonacci spiral).**
2. **Create a rhythmic ostinato pattern in 4/4 time by clapping, clicking, beat-boxing, and so on. Your ostinato pattern must accentuate your chosen number(s) of the spiral, for example Group 1 can clap 1, 2, 3, 4, like a kick drum. However, those who chose 3 4 could clap 1 2 3, then 1 2 3 4. Alternatively, you could click on every 3rd and 4th beat; it is up to you how you interpret your numbers – be creative.**
3. **The task is finished when each group can a repeat their pattern and b perform their pattern against another.**
4. **What do you notice can happen when you all play together?**

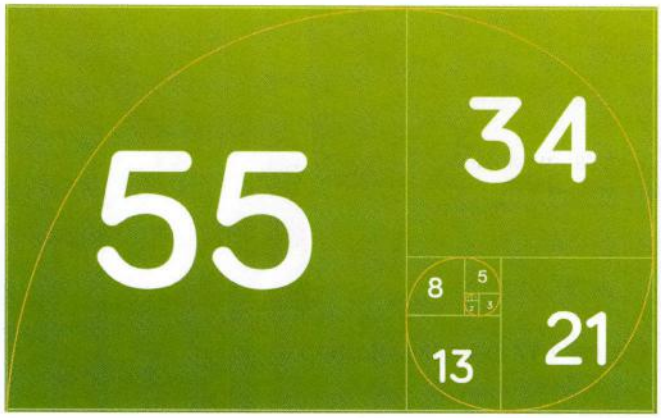


Figure 1.19 Fibonacci spiral from the app 'Incredible Numbers' (see page 9)

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Developing skills.

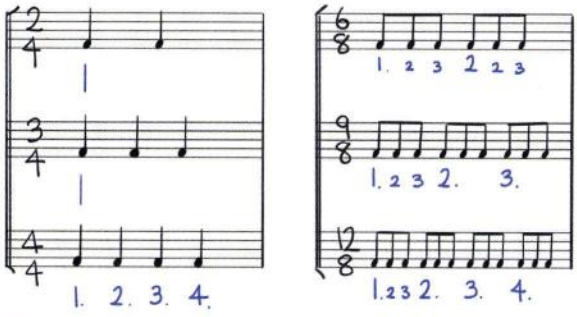


Figure 1.20 Time signatures and note values

Having used body percussion and vocussion to express the Fibonacci sequence, let us go to a different rhythmical focus: the **time signature**.

In music, the top number tells us *how many* beats there are in a bar, whereas the bottom number tells us what *type* of beat is used.

A time signature is not a fraction, for example 2/4 means two **crotchet** (quarter) notes per bar; 6/8 means six quaver (8th) notes per bar. As you can see from Figure 1.20, we can also **subdivide** these beats, as long as they add to the top number in the time signature.

If we continue this pattern of using 2s and 3s, we can get 2+3=5 (Fibonacci), and 2+3+2=7 (not Fibonacci), 2+2+2+2=8 (Fibonacci), and 3+3+3=9 (not Fibonacci). However, if we combine these three results, like the band TOOL did in their track 'Lateralus', with alternating time signatures of 9 8 7, we get the 16th number of the Fibonacci sequence (987) and a very clever use of the Fibonacci sequence to decide which time signatures to use in a piece of music.

ACTIVITY: Movement in time

ATL

- Communication skills: Interpreting and using effectively modes of non-verbal communication

Using the following pieces from the playlist, you are going to move your body in time to the correct time signatures *and* rhythm groupings. The emphasis will be on showing the rhythmic layers of each work through physical movement, for example if you play Dave Brubeck's 'Take Five', you want to move, dance or clap in time to 5/4, but accentuate the grouping of 3+2. Then, if you play '5/4' by Gorillaz, you will want to emphasise the grouping of 2+3 with the guitar part.

Track	Artist	Album
Five	CoCo's Lunch	Invisible Rhythm
5/4	Clogs	Lantern
5/4	Gorillaz	Gorillaz
Money	Pink Floyd	Dark Side of the Moon
7/4	Dave Brubeck	Unsquare Dance
I was brought to my senses	Sting	Mercury Falling

The aim is to **create** a series of body shapes and movements to the music. Remain fixed to the floor and ensure you have space around you. Listen carefully to discern the rhythmical groupings and time signatures. They will **use** combinations of 2s and 3s.

1. **Begin with lower level movements (kneeling on the floor) showing percussion sequences with the floor.**

Figure 1.21 Teachers dancing to 'CoCo's Lunch'

2. **Next, move to middle level (standing but fixed) using patsching, stamping and clapping.**
3. **Finally, move to upper level (arms above head and shoulders), showing shapes that outline the music's patterns.**

As a class, comment on the way each band / artist used rhythmic groupings and how they layered them within the works. You are engaging in the musical concepts of **duration** and **texture**.

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills, Criterion C: Thinking creatively and Criterion D: Responding.

THINK–PUZZLE–EXPLORE

Listen to the track 'Lateralus' by TOOL and discuss the following questions in groups:

1. **What do you think about the Fibonacci number sequence now?**
2. **What unanswered questions / puzzles do you still have?**
3. **How can you explore this topic further in music?**

Hint

You can find more Fibonacci connections to the band TOOL with a web search and by graphically notating sections of the work 'Lateralus'.

How does a repetitive structure relate to music, mathematics and coding?

ENTER THE NUMBERS 2 AND 3

THINK–PAIR–SHARE

Visualising rhythms from all over the world is possible when we break down patterns into visual rhythmic groupings.

If you have taken any music theory courses, you will recognise the types of questions where you are asked to visualise the beats in a bar and add the correct time signatures. Traditional visualisation questions regarding the whole of a bar are common in the Western tradition, but after watching the video 'A different way to visualise rhythm' at **https://youtu.be/2UphAzryVpY**, **think** about what you learnt from how the video displayed its rhythmic ideas. Then get into **pairs** and discuss this before **sharing** your thoughts with the class. (See Figure 1.22)

ACTIVITY: 2 against 3

ATL

- Creative thinking skills: Focusing on the process of creating by imitating the work of others

In Cuban and other styles such as Latin jazz, there is a grouping of beats called a **clave pattern**. These are also grouped into 2s and 3s and they look like Figure 1.23. You can perform a 3–2 clave or a 2–3 clave depending on the style of music.

Perform the 3–2 **son clave** as a loop and then move directly into the 2 against 3 pattern. Do you think it is easier to follow the notated examples or circular notation to capture the grooves? Investigate this web resource: **https://mathsciencemusic.org/#/project/groove-pizza** to experiment with making some of your own circular rhythm patterns.

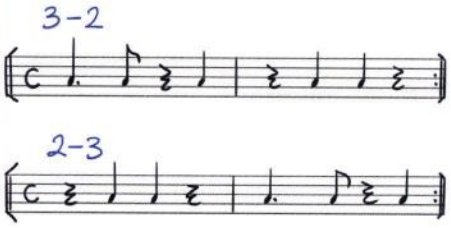


Figure 1.23 3–2 and 2–3 Clave Patterns

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Developing skills.

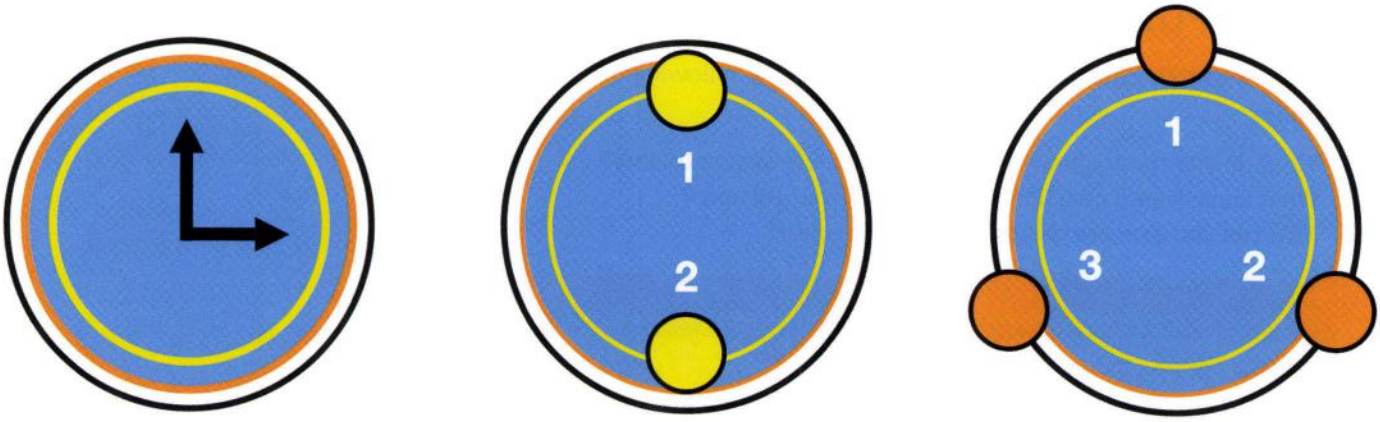
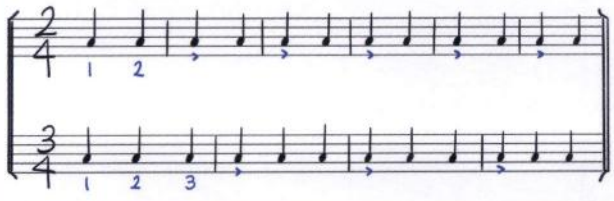


Figure 1.22 Rhythm circles

MEET THE MUSICIAN: CLAYTON CAMERON

Jazz drummer and presenter of the TED Talk 'A rhythem-etic', Cameron presented three short talks on the mathematics behind the music. Visit this link: www.npr.org/programs/ted-radio-hour/388518439/solve-for-x to explore his ideas on 'Why Is Three A Magic Number?' and 'Can Math Make You A Better Musician?'. What is interesting is how closely all these examples use small groupings of notes, in looped and layered patterns. Below is a notated example of a pattern of 2 and 3 lined up so you can see how Cameron performed it. Try to perform this as body percussion within your class.

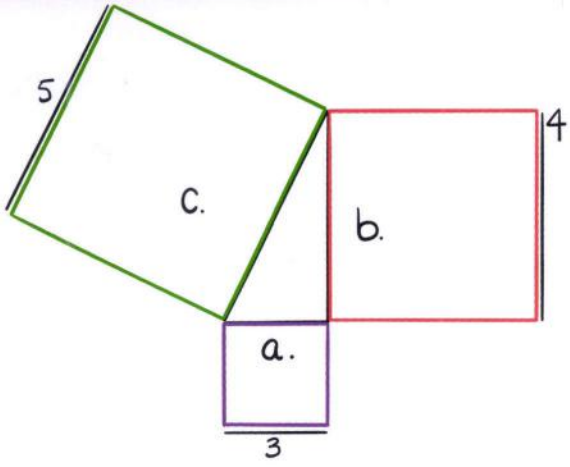


■ **Figure 1.24** 2 against 3 for body percussion

EXTENSION

Ensemble performance

Investigate the music of Australian composer Ross Edwards with his 'Ecstatic Dances No. 2': www.australianmusiccentre.com.au/work/edwards-ross-ecstatic-dances. You will find that he has notated two signatures against each other in the sample score at the link provided. How would you start to rehearse this together?



■ **Figure 1.25** Pythagoras' theorem and music

By now you will have noticed that cultures around the world communicate rhythms in similar ways. Secondly, you will have noticed that symbols are used either to communicate how a rhythm is to be performed, or which beats need to be accented more strongly. Thirdly, you will have noticed that the repetition of numbers and patterns referenced throughout this chapter are a part of how music is remembered, or passed on. If we establish that music is *like* a language, we are beginning to uncover some of its *vocabulary*. And, with a **developing** vocabulary of music that includes concepts like *loops*, *functions* and *sequences*. Let us look at the work of a philosopher called Pythagoras.

Pythagoras of Samos was an early Greek philosopher and mathematician born around 570 BCE. Pythagoras and his followers '... believed that everything in the world was governed by mathematical shapes and numerical patterns'. He has been credited for the theorem of right-angled triangles a2+b2=c2, which you will have encountered in studying mathematics. The theorem produces a series of three numbers called *Pythagorean triples*; that is, the three whole numbers that define the sides of a right-angled triangle, for example if we apply Pythagoras' theorem to a triangle with sides of lengths 3, 4, 5, we get 9+16=25. This can be repeated with other groups of triples: {5, 12, 13}, {6, 8, 10}, {7, 24, 25}, {9, 40, 41}. That we have a geometric shape that has naturally occurring whole numbers is of great benefit to musicians. Look at the number sets above and think back to Fibonacci and time signatures. We have everything we need to start making some grooves.

ACTIVITY: Pythagorean triple beats

ATL

- Creative thinking skills: Constructing mathematical models of rehearsed actions

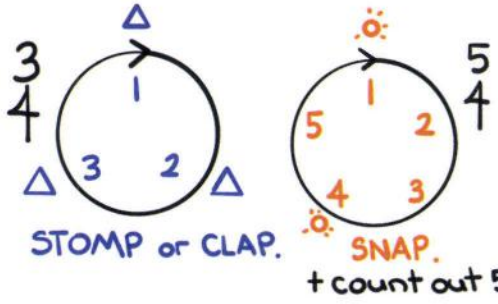
Try a simple activity of stamping on beats 1+2+3+4+. Speak the word 'left' on each whole number and 'right' on the + symbol; you will find you are marching left, then right, on the spot. Now try clapping on beats 3 and 4. If you are doing this slowly it will be easy to accomplish. If you add the number 5 into the activity, you will be clapping on beat 1 every second repetition, for example, 1+2+3+4+ / 5+6+7+8+ /.

The physical action of **using** your body to perform three simple numbers, in layers, is the basis of **creating** a groove.

Using Pythagoras' theorem, we can see that there are certain groups of numbers that form *triples*. Our aim is to create a combination of rhythms that we can perform and then notate using a circular form of graphic notation.

You can do this online with Groove Pizza: **https://apps.musedlab.org/groovepizza** and an iOS app called Patterning: **www.olympianoiseco.com/apps/patterning**, or in your portfolio by hand.

1. **Choose a set of Pythagorean triples (for example 3 4 5). You can search for others online.**
2. **In a small group, decide how you want to loop a rhythmic pattern of 3 4 5. It could be done like the jazz drummer Clayton Cameron using accents in a fixed time signature, or set out in a line like the 3–2 son clave.**
3. **Once you have decided how you will perform and loop your rhythms, try to represent your pattern visually in a circle. Test out the accuracy of your pattern by performing for another group while presenting your circle notation.**



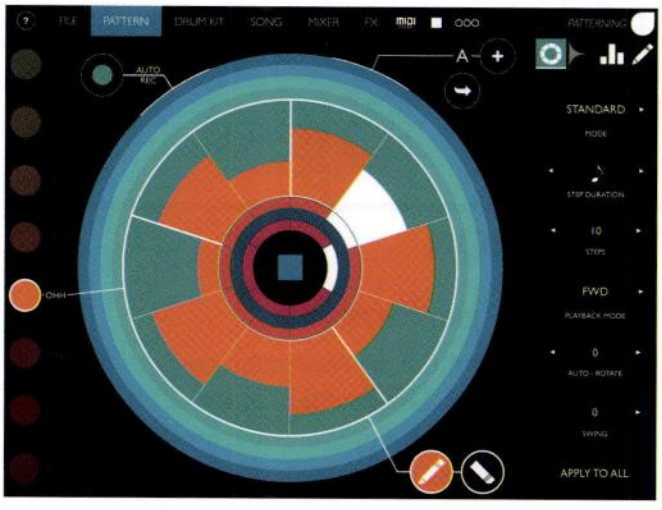


Figure 1.26 Example circle rhythms in 3-4-5 and Groove Pizza examples using Pythagorean triples

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Developing skills.

How does the concept of *structure* relate to music, mathematics and coding?

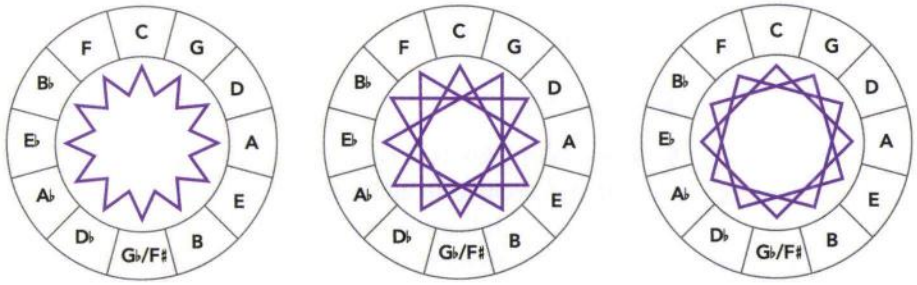
PYTHAGORAS AND CIRCLES OF SOUND

Not only do we owe Pythagoras and his followers for helping us find the hypotenuse, but he is also credited with finding a unique system of ratios for determining intervals in music; intervals such as the octave, perfect 5th, perfect 4th, and so on.

Remember, musicians define intervals as the distances between pairs of notes; distances such as 5ths, 3rds, octaves, and so on. Each interval has a unique tone quality, shape and mathematical ratio. As reported by Ptolemy in his *Harmonics* around 150 CE, the Pythagoreans discovered that when two strings have lengths in ratios of 1:2 (for example, 10cm : 20cm is an octave), 3:2 (30cm : 20cm is a 5th) and 4:3 (40cm : 30cm is a 4th), they produce harmonious sounds, for example, C–C (one octave higher) and C–G (a perfect 5th apart).

In fact, if we go back to the circular idea of rhythm, and add pitch to it, we find more geometric shapes connected to intervals. Much like the **ouroboros**, musical intervals can be represented in a circle known as the *Circle of 5ths* (C moves towards the right to G and then D, all five notes apart). Moving towards the left from C, we get 4ths that rotate to F then B♭; all four notes apart.

The reason these shapes work so well is because of the *harmonic series*, which is a sequence of intervals based on the frequencies of sound as they vibrate through the air. Much like light has a spectrum of colours, one note can have a spectrum of frequencies. Listen to Leonard Bernstein demonstrate this on the piano: **https://youtu.be/iDTj6tBnHlA**. How good is your hearing?

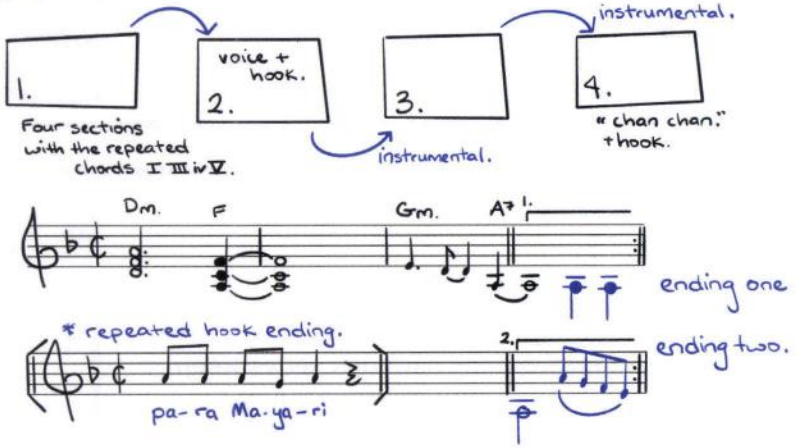


■ **Figure 1.27** Geometric pitch circles: Circle A (5ths, 4ths), Circle B (major 3rds, minor 6ths), Circle C (major 6ths, minor 3rds)

Listening strategically: Get an IDEA

When you listen to music, try to think of the acronym **IDEA** to help you respond with knowledge, and correct terminology.

Listen to the piece 'Chan Chan' in the playlist and write in your portfolio what you can **identify** in this short excerpt. Try to **describe** any patterns you can hear in the rhythm, such as the *son clave*. Take particular note that the melodic instruments also play rhythms and **lock into** (line up with) patterns of other instruments. An example has been provided for you to add more detail to (**explain** and **analyse**) as you listen to the work:



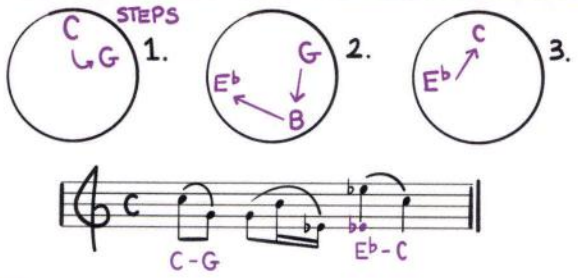
■ **Figure 1.28** 'Chan Chan' listening structure map

ACTIVITY: Circular melodies

ATL

- Creative thinking: Make unexpected or unusual connections between objects and / or ideas

Using the circles in Figure 1.27, generate a series of short melodic patterns that we can experiment with. Start on C and move between the three circular shapes. For example, C moving clockwise to G in the first circle (perfect 5th interval), then keeping G we move to the second circle and move clockwise from G to B to E♭ (all major 3rd intervals) and then keeping E♭ we go to the third circle and move clockwise from E♭ back to C.



■ **Figure 1.29** Composing with circles just works!

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills and Criterion C: Thinking creatively.

ACTIVITY: South Indian talas

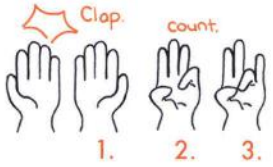
ATL

- Communication skills: Using intercultural understanding to communicate ideas

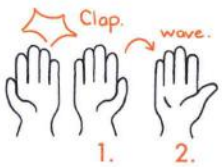
We will now sit and clap what is known in Indian music as a **tala**. A *tala* is a rhythmic cycle that continues throughout a work called a **korvai** (a rhythmic composition). In the Southern Carnatic Indian tradition, the shortest 'rhythm circle' is made up of 3 beats, while the longest has 29 beats.

In this activity we will look at two talas in 3 and 5, while singing the intervals of the ratio 2:1 (an octave A–A') and 3:2 (a 5th A–E).

1. **Start by humming a drone on the note A. Find a comfortable range and have everyone hum that pitch.**
2. **Introduce the A' an octave above and choose half the group to sing this pitch on an *oooh* sound.**
3. **Lastly, introduce the note E (the 5th) and choose a group to hum this pitch.**
4. **In Carnatic Indian music, the tala of 3 beats is called *eka* and you perform it with a *laghu* (clap of the hand, then counting of the 5th and 4th fingers – Figure 1.30).**



■ **Figure 1.30**



■ **Figure 1.31**

5. **The tala of 5 beats is called *rupaka*. It is performed with a *drutam* (clap and wave of the hand in Figure 1.31) followed by a *laghu*.**
6. **As a group, prepare to sing the octave on A and the 5th interval again as a drone. Then while singing, clap the cyclical tala patterns of eka or rupaka. Can you do it?**

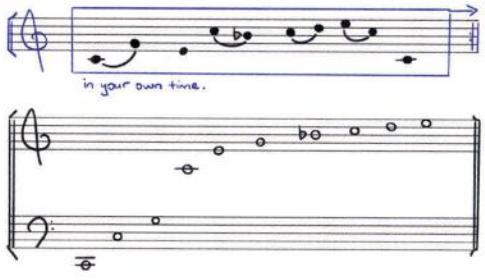
Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills.

EXTENSION

Ensemble performance

With your ensembles, have each person sing or play one note at a time from the harmonic series. Keep the notes sustained and listen to the result. You will get an incredible blend of tones that you can experiment with!



■ **Figure 1.32** Harmonic series for voice

SEE–THINK–WONDER

ATL

- Creative thinking skills: Making guesses, asking 'what if' questions and generating testable hypotheses

Here is an image of a student's vocal composition **using** graphic symbols to represent sounds she made with her mouth. The entire work is based on the instrumental *sequenzas* by Luciano Berio (1925–2003), who we will investigate in later chapters. What do you **see**? What do you **think** about the symbols and shapes? What does it make you **wonder** about her composition process?

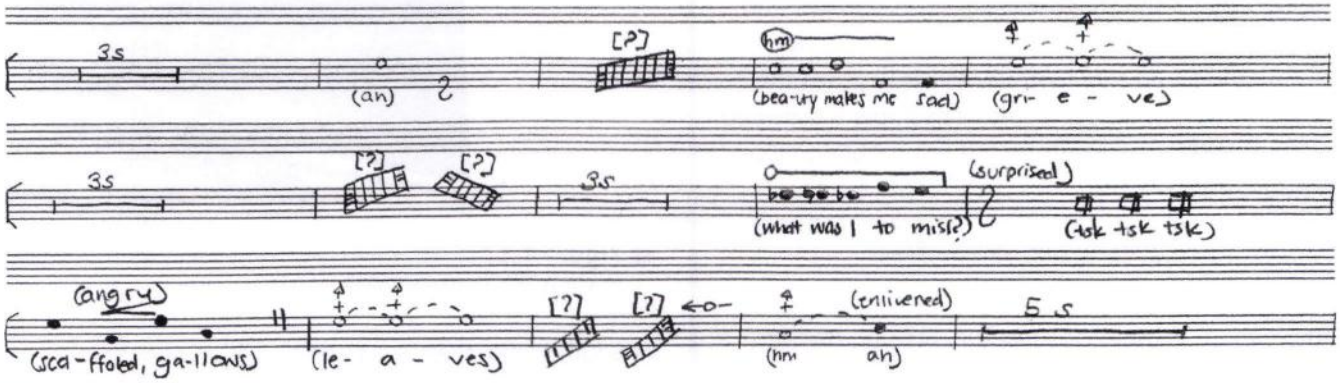


Figure 1.33 Student graphic composition, 'At Crossed Purposes'

DOTS, SQUIGGLES, SOUNDS AND DRUMS!

Figure 1.34 Examples of graphic notation in software

Notation in music is simply a method of writing down what is to be remembered and then performed. It is a way of communicating sound that relies on the interpreter (here the performer) deciphering the message as best they can.

Think of it like a form of code where the performer sees the *commands* and *functions*, and then performs them using their expression and knowledge of the art form.

For example, in the Baroque period (17th Century) composers such as François Couperin (1668–1733) would write a keyboard **suite** with one of the movements titled 'Courante'. This meant a movement that was written in 3/2 time with a change at the end (or cadence). Performers of the time needed to be aware of such an instruction. In modern scores, the composer goes so far as to direct each and every volume marking (dynamics), how a violinist should hold their bow, which mallets a percussionist is to use and how a colour is to be sung! To do this, composers and performers developed symbols for communicating musical messages. Not all forms of notation mean you have to use actual notes; very often, graphic scores can include shapes, colours and time lines.

THINK–PAIR–SHARE

ATL

- Transfer skills: Comparing conceptual understanding across multiple subject groups and disciplines

Using the software program Liquid Music, here is a dubstep *loop* in graphic notation (Figure 1.35). The framing shows it is 4 measures long, with the kick playing the characteristic triplet (grouping of 3 notes) on top. Notice also that there are vertical spikes that refer to **velocity** (how hard the beat is struck can be varied). It is an excellent way to break down the components of a genre. A second example is provided of the same beat in a grid format using Ableton Live (Figure 1.36).

How does art contribute to the power of graphic scores?

Think about concepts such as line, texture, rhythm, colour and space. Note down your answers in your portfolio and **pair** with a partner to search for other ways to notate popular drum patterns, then **share** your findings with the class.

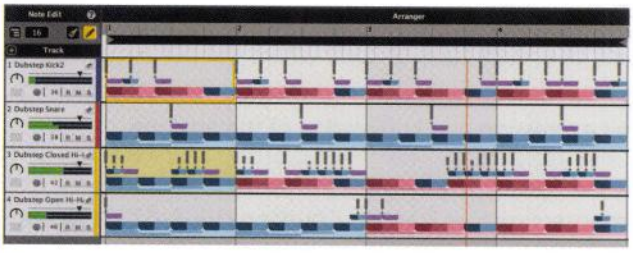


Figure 1.35 Dubstep loop in Liquid Music

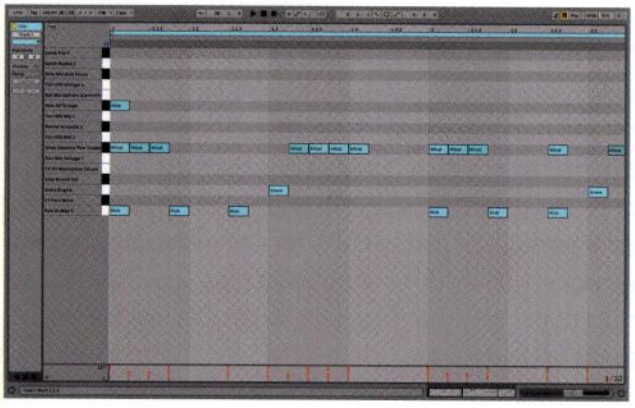


Figure 1.36 Dubstep loop in Ableton Live

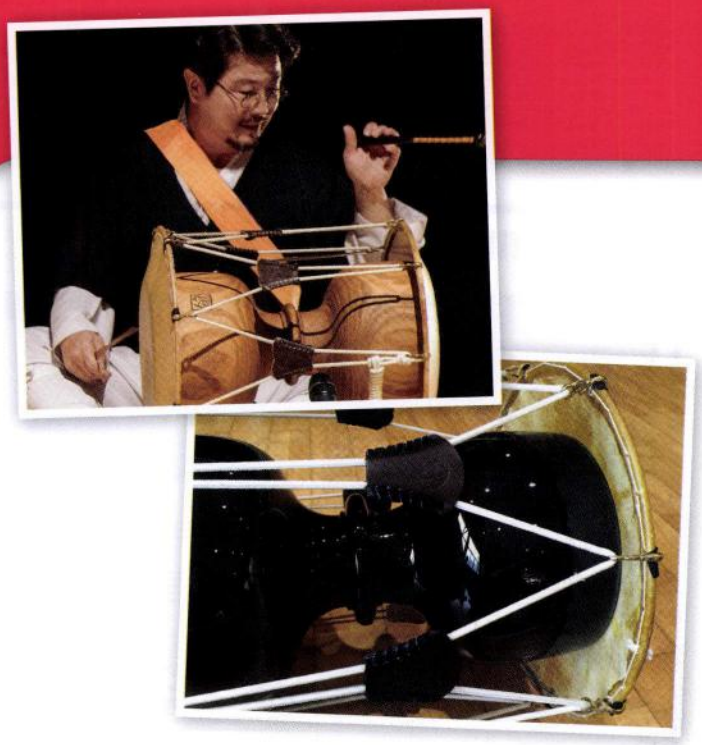


Figure 1.37 Artist, musician, composer Dong-Won Kim playing the janggu, 2015

In South Korea, there is a traditional form of drumming that has been preserved by masters such as Dong-Won Kim. Dong-Won is a member of the SilkRoad Ensemble and instructs on traditional music, including improvisation, all over the world. He currently teaches music as a professor of Wonkwang Digital University in South Korea. When it comes to music, Dong-Won speaks particularly about rhythms. The rhythms he demonstrates are like a language that is derived from research into the different playing techniques of styles in Korea called *samulnori*, *p'ungmul* and some *shamanist* rituals. Furthermore, particular patterns have **vocables** that sound like the double-headed drum he plays, called a *janggu*. Strokes are made with two mallets; one for low tones called *gungch'ae* and one for high tones, *yolch'ae*. The vocal sounds are notated using a combination of lines and shaded circles.

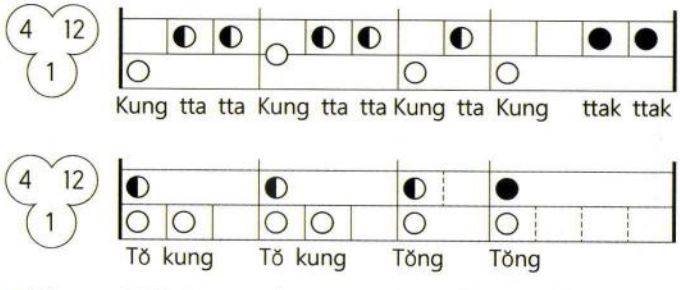


Figure 1.38 Korean drum notation with vocables (provided by Dong-Won Kim)

ACTIVITY: Korean drum notation

ATL

- Communication skills: Using intercultural understanding to communicate ideas

Following Figure 1.38, draw up your own grid of spaces and add in your own circle style notation. You may not have a janggu with you, but you can chant the vocables or **use** body percussion.

A student example is given in Figure 1.39. Notice that the circular symbols in each grid have a vocal sound that you need to chant first.

Use an audio recording device (GarageBand, SoundTrap or iZotope's mobile audio recorder on your device) to document your own performance.

Figure 1.40 Book written by Dong-Won Kim about the Tale of Samulnori; it is being recorded with a USB microphone to GarageBand

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills and Criterion C: Thinking creatively.

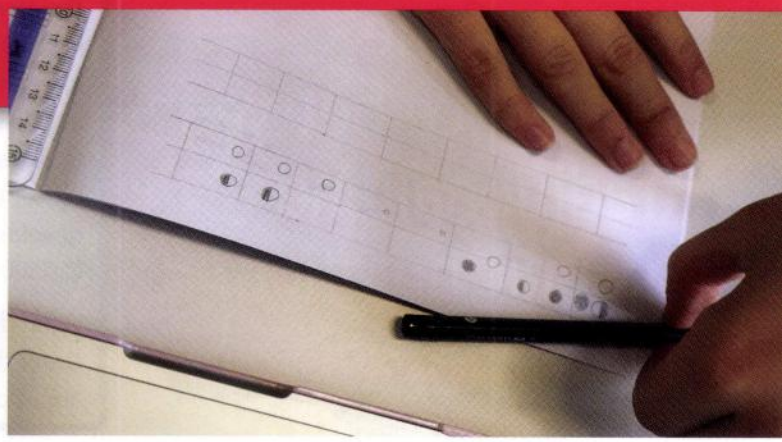


Figure 1.39 Korean drum notation by a student

I USED TO THINK... BUT NOW I THINK

'5 1/2 Examples of Experimental Music Notation' is an article from Smithsonian: **www.smithsonianmag.com/arts-culture/5-12-examples-of-experimental-music-notation-92223646**. Read through it as a class. This chapter has looked at many different aspects of representing sound as a language. What did you think when you began this chapter? Take a minute to think back and discuss this question with your class.

Then write down your own point of view in your portfolio, starting with: **I used to think...**

Now, whether your ideas have changed or just been challenged, write a few sentences starting: **But now I think...**

EXTENSION

Ensemble performance

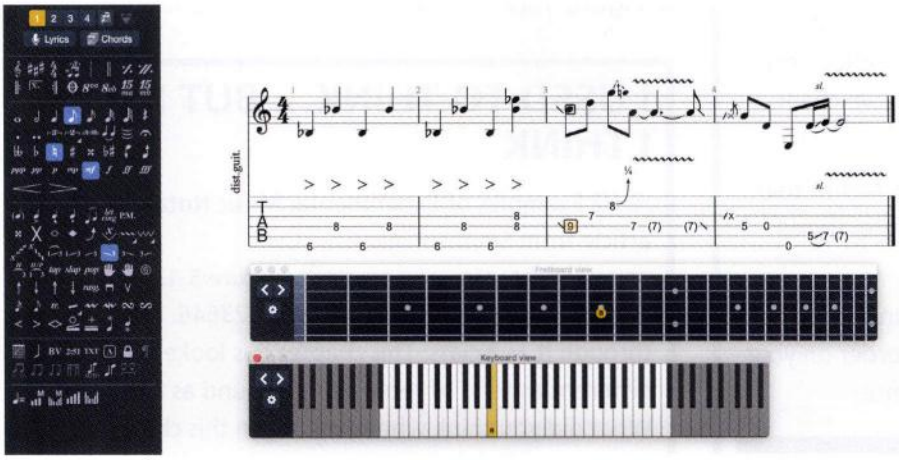
Visit the website of J.W. Pepper to see the work entitled 'Voodoo' by Daniel Bukvich (Wingert-Jones Publications: **www.jwpepper.com/Voodoo/2260180.item#.XmasHi8o-fA**. With your ensemble director, you could either analyse the work with its audio and score preview, or perform it live. What do you notice about the way the music has been written?

What is the difference between traditional and graphic notation?

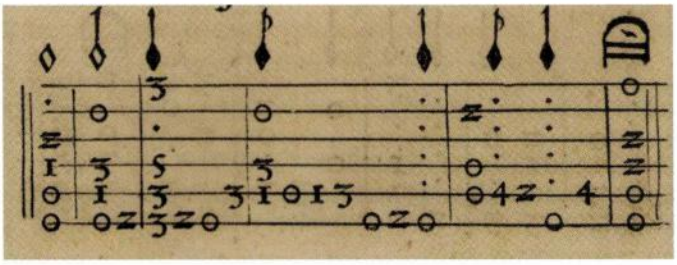
SEE–THINK–WONDER

Jimi Hendrix is well known as one of the most influential guitarists of his time. In Figure 1.41, you can see the opening of his 'Purple Haze' in traditional and guitar tablature notation, or **tab** as guitarists call it. Tab is a form of mapping that communicates to guitarists where to place their fingers to perform the required notes. It is not a new concept, but the extra symbols and directions on the image have **developed** over time. Figure 1.42 shows a work by Luis de Narváez (c. 1500–c. 1550) for Vihuela/Lute (an early ancestor of the guitar).

What do you **see** when comparing the two examples? How do you **think** this method was invented? What does it make you **wonder** about other instruments and ways of notating sound?



■ **Figure 1.41** Guitar tablature of the opening of Jimi Hendrix's 'Purple Haze', made in Guitar Pro 7



■ **Figure 1.42** Lute tablature by Narváez as an instruction on page 3 of his publication

HENDRIX, CODING AND COLOUR IN MUSIC

Music can be represented by all forms of symbols. Here we get to use actual code, with thanks to two easily available resources. Imagine you have a performance coming up and you could program with commands and functions everything from the tempo to the sample being looped. Then, mid-performance, you want to change the sample or melody live. This concept was recently discussed in an article by WIRED entitled 'DJs of the Future Don't Spin Records – They Write Code': **www.wired.com/story/algoraves-live-coding-djs**. You never know; you may be the next hit DJ!

1 **https://microbit.org** has a platform where you can edit all your code before downloading it to a small computer board. **https://makecode.microbit.org** is the place to start creating. Having the actual device is optional, we are first experimenting with the code to make music.

Hint

Visit this website for more detailed information: **https://microbit-micropython.readthedocs.io/en/latest/music.html**

2 **https://sonic-pi.net** is a computer-based platform for Mac or PC created by Sam Aaron (**https://twitter.com/samaaron**) focused on code-based creation and performance. With it, you can DJ live and code your own music with its built-in samples.

ACTIVITY: Coding with Sonic Pi and micro:bit

ATL

- Communication skills: Following instructions accurately. Understanding and using mathematical notation

The aim of this activity is to represent a melody **using** computer code as a form of notation. Screenshots are provided below to show you what the final product should look like.

We are going to start with a remix of sorts called 'Variations on a Theme' by George Frideric Handel (1685–1759) from his work *Air with Variations HWV 430.*

Open the Makecode program for the micro:bit and enter the notes for the main melody in Figure 1.45. Be aware that you need to choose the length of the note carefully. You will notice that the tune itself has numbers underneath. These connect to the pitches on the keyboard and how we can code them into our chosen programs. Micro:bit's software allows you to choose the notes with blocks directly, whereas in Sonic Pi you need to be aware of something called *MIDI* (numbers representing pitch for a computer) and *play* and *sleep* commands.

Open Sonic Pi and enter the details shown in Figure 1.46. A second layer of code is provided underneath to add a drum loop that repeats continuously. Now can you make musical edits to the piece live?

A *command* is something that is carried out; the *functions* group those commands into a string of events (such as perform with tempo BPM is 80). Document this process in your portfolio and experiment with altering the notes and samples in Sonic Pi. We will revisit these programs in later chapters.

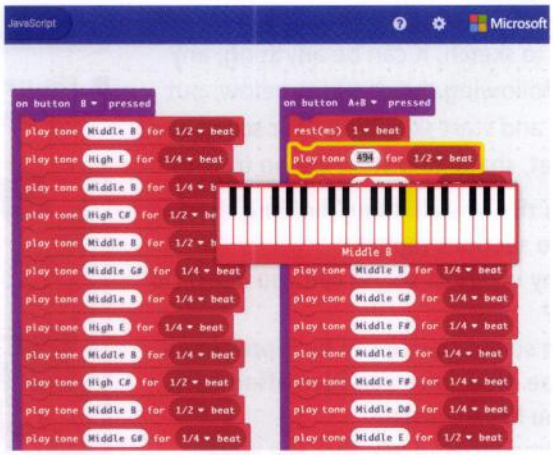
Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills and Criterion C: Thinking creatively.

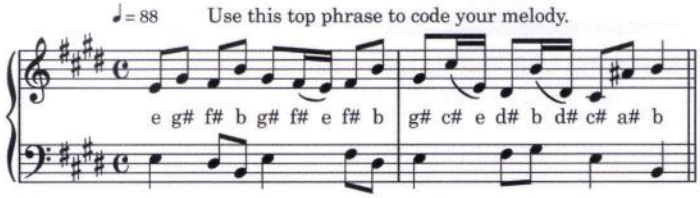
Blocks | JavaScript

```
input.onButtonPressed(Button.A, function () {
    music.setTempo(80)
    music.playTone(330, music.beat(BeatFraction.Half))
    music.playTone(415, music.beat(BeatFraction.Half))
    music.playTone(370, music.beat(BeatFraction.Half))
    music.playTone(494, music.beat(BeatFraction.Half))
    music.playTone(415, music.beat(BeatFraction.Half))
    music.playTone(370, music.beat(BeatFraction.Quarter))
    music.playTone(330, music.beat(BeatFraction.Quarter))
    music.playTone(370, music.beat(BeatFraction.Half))
    music.playTone(494, music.beat(BeatFraction.Half))
    music.playTone(415, music.beat(BeatFraction.Half))
    music.playTone(554, music.beat(BeatFraction.Quarter))
    music.playTone(330, music.beat(BeatFraction.Quarter))
    music.playTone(311, music.beat(BeatFraction.Half))
    music.playTone(494, music.beat(BeatFraction.Quarter))
    music.playTone(311, music.beat(BeatFraction.Quarter))
    music.playTone(277, music.beat(BeatFraction.Half))
    music.playTone(466, music.beat(BeatFraction.Half))
    music.playTone(494, music.beat(BeatFraction.Half))
})
```

■ **Figure 1.43** Handel for micro:bit



■ **Figure 1.44** Handel's theme for micro:bit Sections A and B



■ **Figure 1.45** Handel's theme from 'The Harmonious Blacksmith'

```
use_bpm 40
live_loop :amen_break do
  sample :loop_amen, beat_stretch: 2, cutoff: 90
  sleep 2
end

use_bpm 80
live_loop :foo do
  play :E4
  sleep 1
  play :Gs4
  sleep 1
  play :Fs4
  sleep 1
  play :B4
  sleep 1
  play :Gs4
  sleep 1
  play :Fs4
  sleep 0.5
  play :E4
  sleep 0.5
  play :Fs4
  sleep 1
  play :B4
  sleep 1
end
```

■ **Figure 1.46** 'The Harmonious Blacksmith' with drums in Sonic Pi

MEET THE ARTIST: MIKE HAMAD

Mike Hamad draws music as he listens to it. What do you imagine when you listen to music? In this video by *The New York Times*: https://youtu.be/vrxh15SCqjM, Mike Hamad outlines how he sketches what he calls a *schematic* using the overall form or structure of a song. Mike uses his aural skills (ability to identify intervals, patterns, notes, rhythms) to create a flowchart or timeline of events in music, as he perceives it.

What other styles of music could this approach work with? What would be the first steps to making these diagrams yourself?

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills.

ACTIVITY: Making a schematic

ATL

- Communication skills: Interpreting and using effectively modes of non-verbal communication
- Information literacy skills: Presenting information in a variety of formats and platforms

Using the example provided by Mike Hamad and the pieces we have discussed so far, your activity is to choose a song that you want to sketch. It can be anything; any style or genre. Then, following the checklist below, put on some headphones and start sketching your schematic. Remember: The format, shape and style are up to you!

1. **Structure: What is the overall 'thing' holding the music together? Do sections repeat?**
2. **Texture: How many layers of sound can you hear? Do they change at all?**
3. **Tone-colour: Each sound source can be represented by a colour or shape. How have you identified each one in the work you have chosen?**
4. **Pitch: Have you demonstrated whether the work has a melody, chords or bass line? Is there a low or high sound source? Or multiple layers playing a repeating melody?**
5. **Rhythm: What style or genre is it? Can you show the main beat? Are there repeating patterns (called *ostinatos*)?**
6. **Dynamics and expressive techniques: Does the volume of the work change? How does it change?**

To the right are two student examples from completely different styles of music.

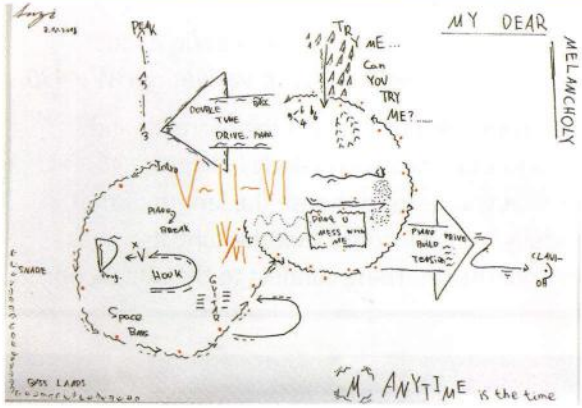


Figure 1.47 'Anytime' by The Weeknd from the album *My Dear Melancholy*

Figure 1.48 The SIAMÉS' 'The Wolf' from their first single 'Bounce into the Music'

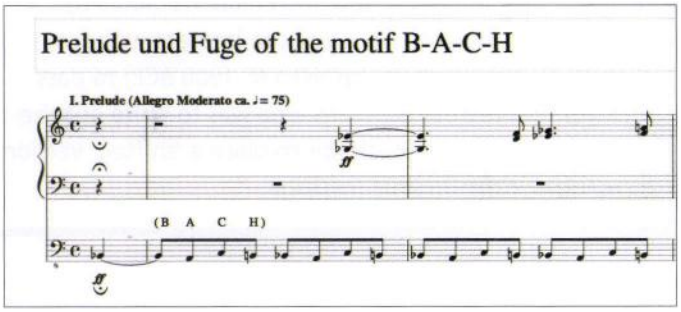
How well have these students represented the building blocks of music? How innovative is their approach?

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion C: Thinking creatively.

Do music and mathematics share the same rules as code?

■ **Figure 1.49** A Caesar cipher, with its circular rings for deciphering messages



■ **Figure 1.50** Franz Liszt's Bach motif in MuseScore

COMPOSING WITH YOUR NAME

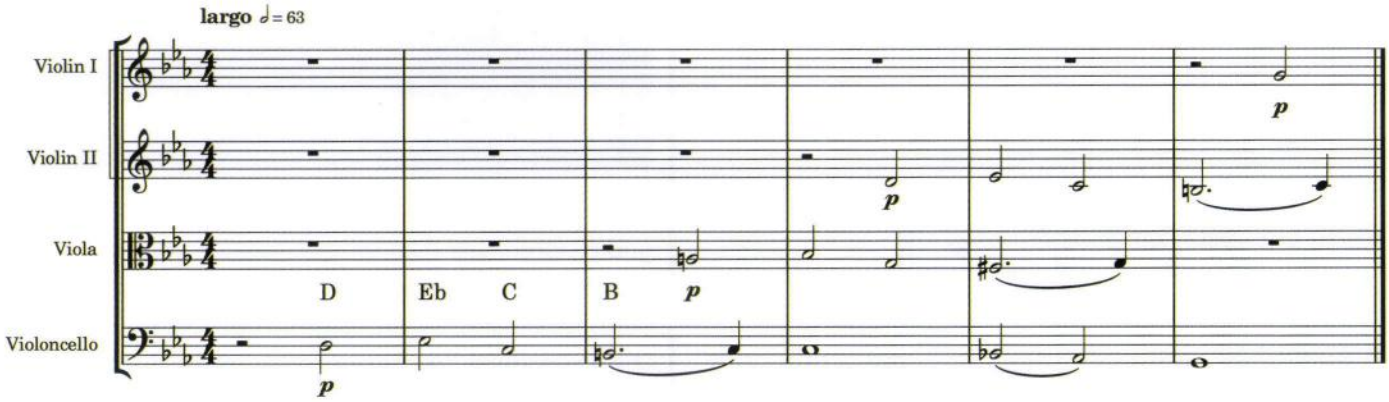
Musical cryptography is an art form of language and music combined. Usually it involves exploiting the relationship between letters and notes, but it can be explored much further. J.S. Bach encoded his name into some of his works using the phrase B♭-A-C-B natural (B natural is H in the German system).

Many other composers have also used BACH's name in their compositions in creative ways. As you will see in Franz Liszt's 'Präludium und Fuge über das Motiv B-A-C-H', composed in 1855, the motif appears from the very start.

Visit **www.wqxr.org/story/277113-top-five-deployments-b-a-c-h** to hear more uses of Bach's name. Then describe in your portfolio how they use B♭-A-C-B.

But what about names (such as yours) that may not work as easily with the notes A-B-C-D-E-F-G?

Dmitri Shostakovich (1906–1975) also used the German system to create his own musical cryptogram by using his initials, rather than his full name. The letters D S C H became D-E♭-C-B, and the incredible *String Quartet No. 8 in C minor, Op. 110* outlines this beautifully in all five movements.



■ **Figure 1.51** Shostakovich's name in code from *String Quartet No. 8 in C minor* '1st Movement'

What makes this **string quartet** special is Shostakovich's continuous changing or development of his encoded theme. The first movement presents it in a type of **canon**, slowly repeating it in pairs but higher each time, then the second movement repeats this idea by making the notes longer and higher. The third movement is very clever in changing the rhythm; the fourth movement changes the notes entirely but you can still hear the shape of DSCH. Then finally the fifth movement presents the theme in the cello with a light counter-melody on top. All of these changes have a musical name: **motivic development**.

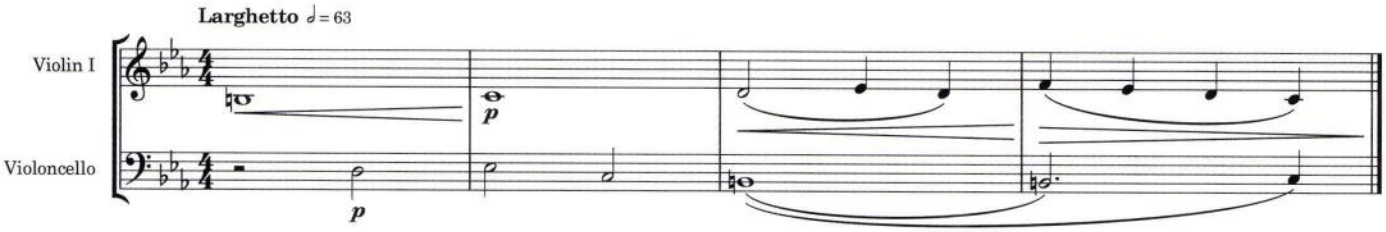
THINK–PUZZLE–EXPLORE

Organise yourselves into small groups and discuss what you **think** a *cipher* is. When you think you have an answer, collectively search the term 'Caesar cipher' online or visit the book / app *Incredible Numbers* by Professor Ian Stewart. Here you can interact with a model of what Julius Caesar used (c. 1900 BCE) to pass on messages secretly. Caesar's idea was to write out the alphabet, and underneath this to place a 'shifted' version to rearrange the original message.

Puzzle: How secure do you think this type of message encoding was? What would you need to break the code?

Without the 'key' (that is, the secret information needed to decode the encrypted text) it would be difficult to interpret what was being communicated. Therefore, in a cipher the *plaintext* (original message) and the *ciphertext* (encrypted message) need an *encryption algorithm* (method to encode the text) and a *decryption algorithm* (method to interpret the message).

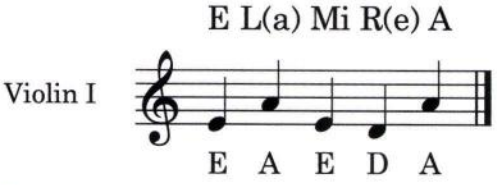
How could you **explore** the world of ciphers further?



■ **Figure 1.52** Shostakovich's name in code from *String Quartet No. 8 in C minor* '5th movement'

Shostakovich uses various techniques to change the length of the notes, the intervals between the notes and even how he layers them on top of each other. This allows him to present his encoded name in many colourful ways. It is recommended that you listen to the 'String Quartet No.8' as well as the third movement of his *10th Symphony* on the playlist.

As a final example, Shostakovich's *10th Symphony* also contains a unique cryptogram spelling out the name of one of his students, Elmira Nazirova, by combining **solfège** (do re mi) and note names. ELMIRA becomes E – L(a) is A – Mi is E – R(e) is D – and then there is A.



■ **Figure 1.53** Elmira's name in code

Musical cryptograms come in all shapes and sizes. But composers started to realise the limits of using the German system.

French musicologist Jules Écorcheville (1872–1915) developed the grid pictured opposite, which you will agree makes the process of encrypting any letter into music much easier. If your name has letters that do not fit the English alphabet you can now add those as well.

A	B	C	D	E	F	G
H	I	J	K	L	M	N
O	P	Q	R	S	T	U
V	W	X	Y	Z		

■ **Figure 1.54**

ACTIVITY: Musical cryptology

■ ATL

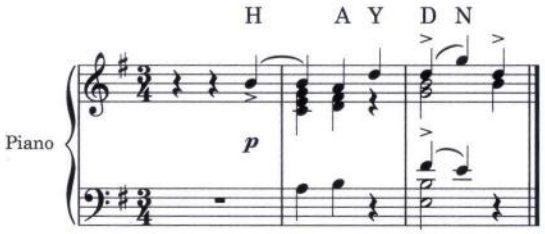
■ Transfer skills: Inquiring in different contexts to gain a different perspective

Using your portfolios, match up your name with the grid pictured, and then using a notation app like Symphony Pro or MuseScore, enter your names as notes on a blank piano treble and bass clef stave. Use any rhythm! You can even copy patterns from Shostakovich as long as you are using letters from your name! Reflect in your portfolio what it sounds like.

◆ Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Developing skills.

Joseph Maurice Ravel (1875–1937) was given the challenge of composing a piece that was based on a cryptogram of Joseph Haydn's name. Ravel's version is particularly beautiful as it uses the French-grid on page 26 to turn HAYDN into B (using the German system for the first note)-A-D-D-G. Ravel **presents** the HAYDN theme forwards, backwards and even upside-down.



■ **Figure 1.55** 'Haydn' encoded by Ravel

ACTIVITY: Ravel and Haydn

■ ATL

■ Creative thinking skills: Focusing on the process of creating by imitating the work of others

Using the musical code that you made of your name in the previous activity, try to **present** your encoded name backwards and upside-down, like Ravel.

Just to experiment, **use** notation software like MuseScore to copy and paste them on top of each other into a piano part. Take screenshots of your experiments and then listen to Ravel's 'Menuet sur le nom d'Haydn' on the playlist. What are some other ways you could imitate Ravel's coding experiment?

◆ Assessment opportunities

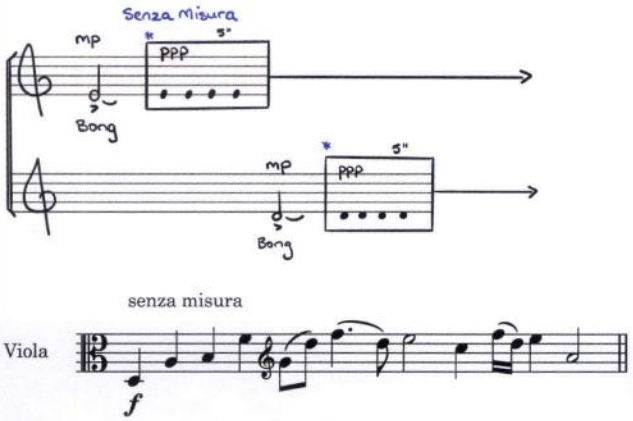
In this activity you have practised skills that are assessed using Criterion C: Thinking creatively and Criterion D: Responding.

EXTENSION

Ensemble performance

We looked at 'Deep Field' by composer Eric Whitacre in an earlier part of this chapter. He has also written a wonderful setting of Hebrew love songs for choir, piano and violin called *Five Hebrew Love Songs*. In the fourth movement there is a part where voices **imitate** bells using a 'musical direction', *senza misura*. This term gives the performer permission to interpret the notes in their own rhythmic time; literally reading it as 'without meter or time'.

If you play flute, viola or other concert-pitched instruments, Gustav Holst (1874–1934) wrote a very similar passage with traditional notation for his 'Lyric Movement' composed in 1933. Again, it gives the performer choice over how to express the opening melody. Listen to both works on the playlist and investigate performing them.



■ **Figure 1.56** Example of 'Éyze Sheleg!' ('What Snow!') with the direction of ***senza misura*** Time in seconds is also given to interpret the notes within the work.

To what extent does music use space / emptiness to communicate?

THINK–PAIR–SHARE

Think about this question in **pairs** or small groups; you can answer it in any way you choose (speaking, chanting, clapping or whispering):

What does it mean to divide a beat? Is it a mathematical term? Or a musical instruction? Or both?

Within your group, think of a way that you can **demonstrate** together what it means to *divide the beat*. Once you have discussed different answers, watch the TEDx video 'Rhythm Effect' at **https://youtu.be/nOwpS7iKV90** and see whether you need to *add to* or *change* your answer. Turn to your partner and **share** your answers to the question: How did the performances demonstrate dividing the beat?

DRUMMING IN SEQUENCE

When drumming, it is always best to use your body and voice to internalise the beat. The beat or pulse can be felt in groups of 2 or 3 as discussed, and repetition is always important. It is through repetition that we build patterns, rhythmic memory and the ability to improvise.

■ **Figure 1.57**

ACTIVITY: Complementary layers game

ATL

- Transfer skills: Combining knowledge, understanding and skills to create products or solutions

As a large group, move chairs and tables out of the way so you can either stand or sit facing one another. The aim of the game is to play rhythms that 'fit' with each other, just like a jigsaw puzzle. The leader begins, clapping a simple pattern in 4, then the second person must join in with a completely different rhythm – avoiding the pattern of the first person. This continues for the third person, the fourth, and so on. The more people that join the game means that the rhythmic 'spaces' will fill up very quickly. This is where you can be creative with sound effects.

What you will notice is that repeated ideas can complement or 'lock into' each other, **creating** amazing rhythmic soundscapes.

Some points to remember while playing:

1. **You will want to remain in the game as long as possible, performing like a human loop machine.**
2. **You cannot perform the same pattern as someone else. You have to fit either inside or outside someone else's space.**
3. **If you play the same rhythmic pattern as someone else, you are disqualified.**
4. **Simplicity is key, and make it fun! Beatbox, whistle, clap, stomp and sing.**
5. **Ensure someone is recording the game, because you will make up some incredible rhythms.**

"Space is an instrument"

Producer Focus quoting Dr. Dre

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion B: Developing skills.

ACTIVITY: Let's drum

ATL

- Communication skills: Using intercultural understanding to communicate ideas

In this activity we are going to experiment with some drumming grooves in the style of Japanese *Taiko*. We will seek to understand how they work as **complementary** layers by learning each rhythm vocally and then playing them in three different ways. In Japanese, the word *renshu* means 'practise': **Using** the examples in Figure 1.58, practise the different combinations. Thanks to **https://taikosource.com**, we have a way of vocalising and writing taiko-styled rhythms.

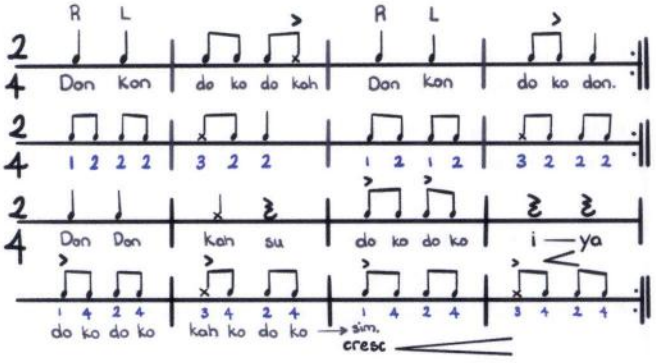


Figure 1.58 Patterns for rhythmic experiments

Experiment part 1: Chanting

Rhythms in taiko can be learnt by using *vocables*. Use the table below to practise the examples in 2/4.

Vocables	Beats	Rests	Vocables
Don, Kon Do-Ko (hit in center of drum)	♩ ♫	𝄽	i-ya
Kah Ka-rah (hit on rim of drum)	♩ ♫	𝄾	Su (can be shorter than Don)
Tsu Tsu-ku (hit in centre of drum)	Same as above but quieter hits / strokes	𝄾	Hup
The bouncing rhythm that gets lighter is called *katarai*.			

Experiment part 2: Pen drumming

Pen drumming is an amazing skill that you can **develop** right now using cipher notation and by watching YouTube: **https://youtu.be/pllrQAcsZqc**. Once you have practised your pen skills, try applying them to the rhythmic patterns in Figure 1.58. The numbers for each note are explained below.

Numbers	Beats	Pen hold
1	♩ ♪	Palm on table
2	♩ ♪	Tip of right-hand pen
3	♩ ♪	Right-hand open flat
4	♩ ♪	Tip of left-hand pen

Experiment part 3: Sticking

This is where you get to use drumsticks! Any pair of drumsticks will do, and if you have gone through the two levels explained you now have a good idea of how the rhythms work. Experiment with alternating your hands from right to left and speeding up or slowing down the tempo. Everyone in your group must perform their part at the same time, with vocal yells!

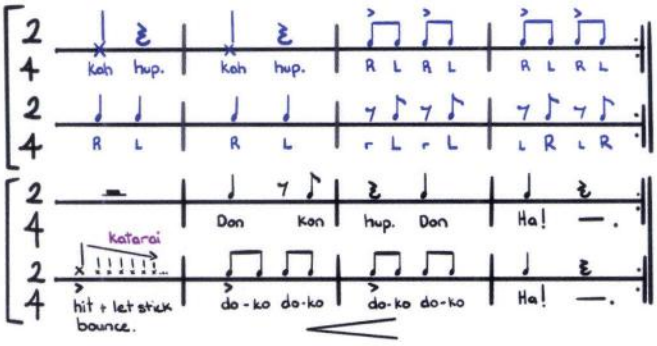


Figure 1.59 Duet renshu-style patterns that you can build on

This activity is an example of using inspiration provided by another culture to transfer and develop your rhythm skills. Add your thoughts on this process to your portfolio.

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Developing skills.

How does music represent a form of communication?

Reflection

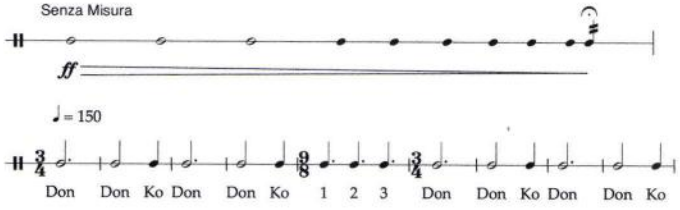
In this chapter, we have **explored** many different aspects of rhythm and *explained* how they fit together in complementary patterns. We have **evaluated** performances and works, **outlining** their structures and *discussing* how they were **created** by taking apart their key components.

As the chapter sought to connect music, mathematics and coding, the premise of music being a language with its own unique rules and symbols was **demonstrated** by *examining* how other composers and performers have approached their art in innovative ways, from codes, ciphers, shapes and colours to phrases, words and dots.

We have analysed aspects of music that compare it to mathematics and coding, seeking to *define* the terms and devices used in cultures all over the world. Ultimately, we have *applied* what we have learned in active and immersive tasks.

SOME SUMMATIVE OPTIONS TO TRY

Use these ideas to apply and extend your learning from this chapter. These problems can be assessed using any of the strands suggested above the summative activities. The presentation and portfolio requirements are given after the description.



■ **Figure 1.60** Student drumming using *senza misura*

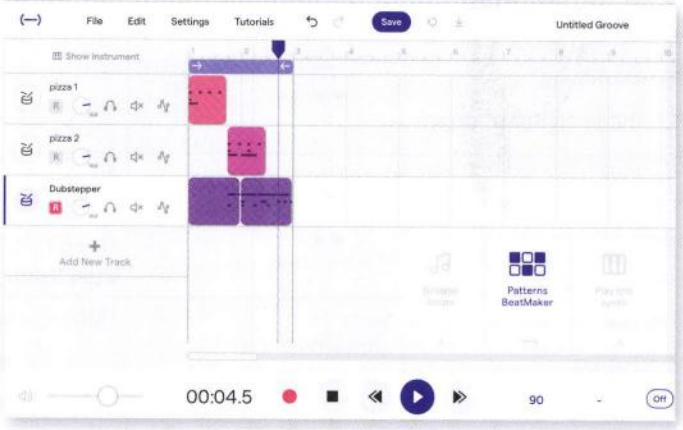
THIS TASK CAN BE USED TO EVALUATE YOUR LEARNING IN CRITERION A AND CRITERION C (ALL STRANDS).

SUMMATIVE 1

Create a drumming experience that **uses** mathematical number patterns for an ensemble of your choice (including pen drumming or taiko). You can start with pi / (π), Fibonacci, Pythagoras or any other number set that you investigate. The goal is to include four people playing a series of layered rhythms in a binary A+B structure.

Presentation and portfolio

Research your mathematical number set and **develop** a page of planning where you sketch out different ways of **using** those numbers for **a** measures or time signatures **b** combinations of patterns **c** groupings of two and three **d** clicks, hits, yells or shouts. Once you have your sketches and a roadmap outlining the order of your work, either record each part into GarageBand / SoundTrap or notate it so you can share the parts with your friends. **Present** the final piece as a live performance or video.



■ **Figure 1.61** SoundTrap rhythmic layers ready for editing

Portfolio presentation

Documenting and sharing

Keeping in line with all your activities and explorations, listen to pieces that include Latin rhythms so you can practise identifying *claves* – patterns of 2 against 3. Keep building your coding skills and using musical software to generate new and experimental works.

THIS TASK CAN BE USED TO EVALUATE YOUR LEARNING IN CRITERION B AND CRITERION D (ALL STRANDS).

SUMMATIVE 2

Develop an ensemble performance that includes the instruments of your choosing, *plus* coded loops that change after certain amounts of time. You can **use** GarageBand, a BBC micro:bit, Sonic Pi or number patterns entered into SoundTrap. You need to have at least one layer that is acoustic. Some professional setups have a keyboard with a laptop or tablet. Your goal is to generate music using coding, and to control it all yourself in a live setting.

Presentation and portfolio

Draw a diagram or roadmap showing your setup with instruments, which patterns the loops are based on, and your coding materials. Include in this diagram how everything should be set up on a stage, how the coding loops will function and how you will perform any live components. **Present** the final performance and video it for peer reflection.

■ **Figure 1.62** Setup example of tablet, diatonic bells and piano with looped chords

Use this table to reflect on your own learning in this chapter.

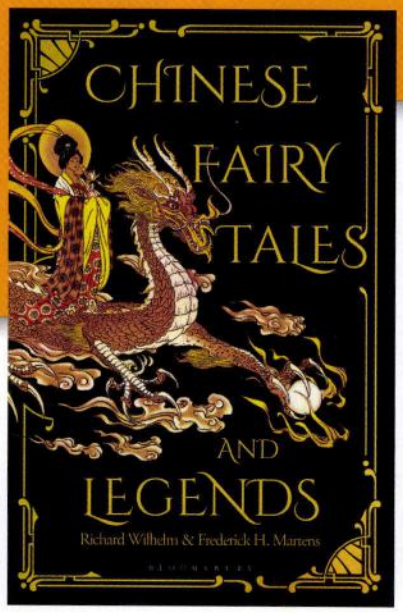
Questions we asked	Answers we found	Any further questions now?
Factual: What are some of the ways sound is used to communicate? What is the difference between traditional and graphic notation?		
Conceptual: How does music represent a form of communication? What are some of the ways mathematics has influenced music? How does a repetitive structure relate to music, mathematics and coding? How can we use patterns and sequences to create music?		
Debatable: Do music and mathematics share the same rules as code? Is music a language? To what extent does music use space / emptiness to communicate?		

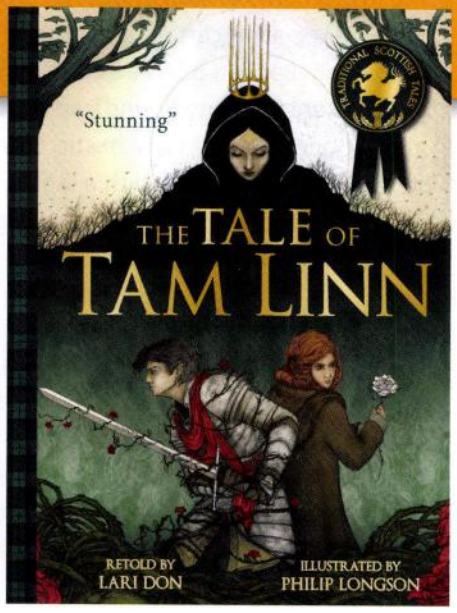
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Communication skills					
Information literacy skills					
Creative thinking skills					
Media literacy skills					
Transfer skills					

Learner profile attribute	Reflect on the importance of communication for our learning in this chapter.
Communicators	

2 Does music have a story to tell?

Identifying the **cultural** context or features of a **narrative** helps us interpret and experience the stories of others.





■ **Figure 2.1**

CONSIDER THESE QUESTIONS:

Factual: What is a story with music called? What is a folk song? Who were the Russian Five? What is strophic form?

Conceptual: How can a story be told through music? Which musical ingredients are needed to narrate a story? How is a musical story constructed? How does music represent people, places or things? How does an artist shape an expression of sound from an image or words?

Debatable: Are all stories simply versions of archetypal myths? Is there an expressive 'fingerprint' of sound that identifies cultures around the world? To what extent does music change or improve a narrative?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL...

- **Find out** how melody, rhythm and harmony can be used to interpret stories or images.
- **Explore** the features of musical cultures, both local and global, to identify the fingerprints of their different styles.
- **Take action** to apply knowledge of musical devices to narrate stories with or without words, using traditional and contemporary techniques to convey meaning.

These Approaches to Learning (ATL) skills will be useful...

- Communication skills
- Information literacy skills
- Creative thinking skills
- Transfer skills

Assessment opportunities in this chapter:

- Criterion A: Knowing and understanding
- Criterion B: Developing skills
- Criterion C: Thinking creatively
- Criterion D: Responding

We will reflect on this learner profile attribute...

- Knowledgeable: We develop and use conceptual understanding, exploring knowledge across a range of disciplines. We engage with issues and ideas that have local and global significance.

KEY WORDS

interval
form
strophic
leitmotif
major
stanza
ostinato
symphonic poem
diatonic
minor
motivic development
programmatic

Prior knowledge

This chapter works on the premise of including all levels of learners. You will find it useful to know:

- how to identify scales and / or forms of notation such as arpeggios or bass lines
- how to notate or recognise groups of rhythms aurally
- how to work collaboratively to express musical ideas with body percussion, voice or instruments
- what working within an ensemble means for balance and intonation
- ways of describing music using pitch, duration, texture, structure, tone-colour, dynamics and expressive techniques
- how to perform different styles of music and about patterns and sequences.

Examples, links and referenced materials will guide you further.

WHAT MAKES YOU SAY THAT?

When Pyotr Ilyich Tchaikovsky wrote his *Symphony No. 4 in F minor, op. 36*, he communicated through his letters that:

> *"The Introduction is the germ, the leading idea of the whole work. This is Fate, that inevitable force which checks our aspirations towards happiness..."*

Listen to the first **movement** on the playlist and you will notice that the repetition of the **rhythm** and **pitch** conveys this message through the orchestra's performance. But would you have thought this had you not read it was the composer's intention?

Figure 2.2 Tchaikovsky's *Fate* motif or theme

Then in the fourth movement, a traditional Russian folksong called 'Beriozka' ('Birch-Tree') is used. **Using** the notation below, sing and perform this melody in your classroom. From the shape of the melody and its sound, what do you think the song is about? Discuss this with a partner and give musical reasons for your ideas.

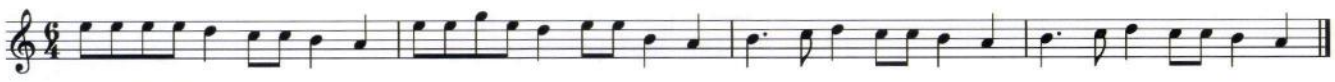


Figure 2.3 'Beriozka' traditional Russian

What is a story with music called?

ACTIVITY: Lament for King Richard

ATL

- Creative thinking skills: Generating novel ideas and considering new perspectives

We all love a good story of heroes, villains, adventures or magic, just the thrill of a tale told expressively captures our imagination. Whether a story tells of love and loss (such as the Greek myth of Orpheus rescuing Eurydice in Monteverdi's *L'Orfeo*), life in the village through a folktune or the triumphs of a hero on the big screen (such as in the score of John Williams' *Indiana Jones*), music conveys a message through its use of pitch, rhythm and harmony that is then interpreted by the listener.

For example, in the famous story of 'Robin Hood', Richard the Lionheart was the king who left on a crusade, thereby starting the heroic journey for Sir Robin as he rebelled against the upstart King John. But did you know, in 1199, the composer Gaucelm Faidit wrote a *lament* for the actual death of King *Richard Coeur-de-Lion* entitled 'Fortz chauza es cue tot lo major dan'. It is a step-wise tune based in D, using repeated notes and small groups of connected 2nd and 3rd **intervals** to convey the sadness felt at the passing of the King.

We interpret the language of this text as emotional because of how it is written and its personal expression. Sing this phrase as a class and discuss how the melody expresses the idea of sadness.

Assessment opportunities

In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Developing skills.

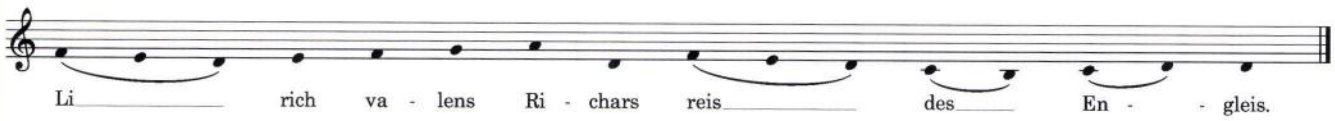


Figure 2.4 Lament for King Richard

Portfolio presentation

Collecting themes

This is the theme for Antonin Dvorak's *The Water Goblin Op. 107.*

Play it on your instrument and add it to your portfolio for future experiments. Does it sound like a mythical theme to you?

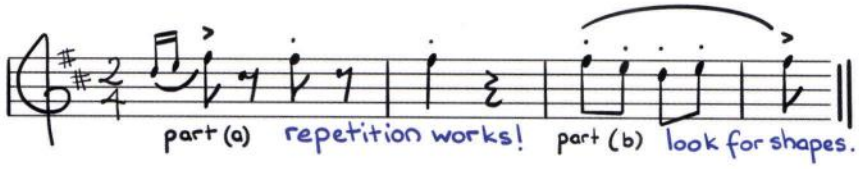


Figure 2.5 Dvorak's Goblin theme